U. S. DEPARTMENT OF THE INTERIOR,
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ART AND INDUSTRY.

EDUCATION

IN THE

INDUSTRIAL AND FINE ARTS

IN

THE UNITED STATES,

BY

ISAAC EDWARDS CLARKE, A. M.

PART IV.—INDUSTRIAL AND TECHNICAL TRAINING IN SCHOOLS OF TECHNOLOGY AND IN U. S. LAND GRANT COLLEGES.

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INTRODUCTION:

PURPOSE AND PLAN OF PRESENT VOLUME.

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PURPOSE AND PLAN OF PRESENT VOLUME.

This volume is, in fact, but a continuation of Part III; issued separately for convenience in binding—The plan and contents are briefly set forth in the first chapter (see pages 1–8)—Main divisions of the volume indicated—The Typical Manual Training Schools—Five Leading Technical Mechanical Schools—Some Trade Schools—The B. & O. R. R. Experimental School at Mt. Clare, near Baltimore, Md.—Finally the Schools of Science and Engineering of the U. S. Land Grant Colleges—These two volumes continue the account of the development of Industrial Art Education in the United States—Brief reference to Parts I and II—Absence of Art Training in American Educational Institutions prior to 1870, noted—Interest in the Fine Arts however existed—Early efforts to establish Public Art Academies and Art Museums—Histories of these early undertakings carefully compiled have been long waiting for issue of the final volumes of this Report—Public Interest in Art Matters largely awakened by the holding of the Centennial and Columbia Expositions—Notable increase in art collections of Statuary and Paintings since 1870—Reference to two Statistical Tables in Part I, showing early poverty of collections of classic art casts before, and remarkable increase in such collections since, the Centennial—The Centennial Exposition first gave to the Public some comprehension of the extent and variety of the artistic manufactures of the world—Wonderful increase since 1876, in facilities in this country, for obtaining knowledge of art matters—Ability and Art of American Architects revealed to the world in the buildings of the Columbian Exposition—This excellence of the architects the normal result of special professional training—These buildings a series of object lessons on the value of definite technical education in a profession—The Permanent buildings of The Boston Public Library and The National Library in Washington, are the logical outcome of this definite training—Reference to Hunt's great Paintings in Legislative Chamber of the Capitol at Albany, N. Y.—Suggestion that we still are living in the Renaissance which began four centuries ago—How the Renaissance arose—Modern art stimulated by recent discoveries of the art works of the Ancients, just as the early discoveries, inspired the great Mediæval Masters—The re-creation of "The Parthenon", as the Art Building of the Nashville Exposition in 1897—This is a striking illustration of the potency of Classic Art in influencing the Art Ideals of to-day—This volume largely given to topics of Technical Industrial and Scientific Training—Art subjects, however, are germane to each volume of this "Art and Industry" Report—Historic works of Art in the Rotunda of the Capitol Building in Washington, D. C.—World contests for Industrial and Commercial Supremacy—Order of Chapters and Appendices of the present volume, "Part IV," given; and contents briefly analyzed and described.

The present volume, "Part IV.," of the Special Report on Industrial Art Education and Fine Art Education in the United States, is, in fact, simply a continuation of Part III., the volume immediately preceding it; the two volumes being issued separately only for convenience in binding. There seems, therefore, little need of repeating

the statement of the conditions accompanying the origin and progress of this Report; since these have already been given in the preliminary pages of the earlier volumes and are concisely summarized in the Introduction to Part III. As in the former volumes the several "introductions" are written by Colonel Clarke, author and editor of this Report. All other matter printed in Long Primer, is also, by him.

As the plan and contents of the present volume are briefly set forth in the opening chapter—(see pages 1–8) it is not necessary to repeat here the details of the classification other than to mention the broad divisions of the volume. Accounts are given of the Typical Manual Training Schools; of Five leading Technical Mechanical Schools; of some Trade Schools; of a most interesting educational experiment undertaken by the B. & O. R. R. under the auspices of President Robert Garrett, in 1885–7; and of the Schools of Science and Engineering of the Land Grant Colleges of Agriculture and The Mechanic Arts. No attempt is made, however, to give a complete view of these latter institutions; the accounts of these Colleges are limited to notices of those departments which give instruction in Drawing and the Industrial Arts.*

These two volumes thus continue the accounts of the development of Industrial Art Education, begun in Part I., by the history of the introduction of the study of Drawing in the Public Schools, and continued in Part II., by accounts of the surprisingly rapid development of Manual Training, as a part of public school education in the United States. A phase of educational activity and enthusiasm which, for a season, seemed to threaten the extinction of any idea of artistic development; and to substitute for the æsthetic culture of the youthful mind, simply a certain amount of manual dexterity in the manipulation of mere mechanical movements, with a limited training in the elements of common industries. All of these practical bits of manual training are useful in their turn but the sum of this training furnishes but a pitiful substitute, as an element of education, for that æsthetic Industrial Art Training which those far-seeing Educators, Walter Smith, John D. Philbrick, and Charles C. Perkins, so succcessfully began in Boston in 1870.

At that era it was evident to all intelligent observers that the one

* For current statistics of these colleges see latest Annual Reports issued by the U. S. Commissioner of Education.

element absolutely lacking in all American Education was the Æsthetic! Art as an essential feature of Education was unknown. It is true that the Literary Arts, Poetry and Oratory, received some little attention in the higher institutions, and that instruction in elementary music was not wholly neglected in the Public Schools; but, so far from any attempt to give even the most cursory knowledge of the Graphic and Plastic Arts, being made generally in the higher Educational Institutions of the country, they were simply ignored; while Æsthetics, were only thought of as forming a subordinate branch of Metaphysics.

This absence of any knowledge of, or training in, the Fine Arts, held true in all American public educational institutions; from the district school to the college. There were then no true Universities, though several small but ambitious colleges were encumbered by the Grandiose Title.

While this statement as to the absence of any general opportunities for seeing examples of the Fine Arts, and as to the lack of any attempt to give a knowledge of the arts of painting and sculpture, in the public schools and other public educational institutions in the United States, is not exaggerated; it is, nevertheless, true that the Fine Arts were not wholly ignored in America; and that, as early as the latter part of the 18th century, the names of some few American artists were known to the world, while early in the present century efforts were made by a few people of culture to establish art centres in several of our cities. Facts relating to the early history of these sporadic efforts to form Art Academies, and public Art Collections, have been most eagerly sought and collected for the present work. These interesting histories will be given in Parts V. and VI. of this Report. In view of the later developments, especially of the growing general interest in, and knowledge of, art matters since the beginning of the movement in Boston, for teaching elementary drawing in the public schools; and the vastly greater impulse to public interest in everything pertaining to Art, given, in turn, by the holding of the Centennial and the Columbian Expositions, the story of these early efforts acquires added interest. To the self-denying efforts of a few artists, and art enthusiasts, were suddenly added the enthusiasm and the active support of an awakened Public.

In view of the many collections of Casts of Antique Sculpture,

and of the private and public Art Galleries, rich in examples of the work of the leading modern artists of Europe, and America, which, as the result of this "awakening", are to be found in the United States, in this year 1898; and of the special art classes and art schools now in our cities, with the very general interest shown in the literature of the Arts, and, further, in view of the present easy access by the public to the before mentioned art collections; the statement concerning the scarcity, in America, as recently as in 1870, of similar opportunities, would seem almost incredible. It is, nevertheless, the fact that, at that date, there were but four or five small collections of casts of classic sculpture in the whole country. Boston, New Haven, New York, Philadelphia and Washington, had each a few examples of such casts; but all the casts of sculpture then in the country, both in public and private possession, would not equal in numbers or value, the casts now possessed by the leading Art Museum in any one of these cities; while in towns, cities, and colleges, all over the land, are to be found valuable and interesting collections of casts and paintings.

Two statistical Tables in Part I. of this Report, show clearly the poverty of this Nation in Public Art Collections, and in opportunities for learning of Art, as recently as 1873.

There were then but eight colleges which gave any instruction whatever in Art, or that had any collections of Art works; while there were but five public Art Museums in the whole land. [See Tables on pages 502–507; Part I. of this Report.]

The Centennial Exposition in Philadelphia, in 1876, was a revelation to the American people, not only of the glory of the Graphic and Plastic Arts, as shown by the world's great living artists, sculptors and painters; but, also, of the variety and beauty imparted to articles of usefulness and ornament by the wonderfully artistic weavers, potters, and metal-workers of the Orient, and by the skilled art workers of Europe.

The impulse then given to public interest in Art, in America, may perhaps be most readily realized by a glance at the Table of Statistics of Institutions giving Art Instruction, and of the public Art Museums, existing in the United States in 1883, given in Part I. of this Report. (See Part I. pages 385–411.) Thirty-seven Institutions, which give some form of Art Instruction, and Thirty Museums of Art, are recorded in these tables.—Certainly a remarkable

increase in the opportunities for art culture provided for the public, to have been effected in the short time of ten years!

The increase in such opportunities since 1883, by the opening to the public of similar facilities for art culture, both by the founding of Public Art Galleries, the making of private collections of art, and the general dissemination of information on all matters relating to the Arts, by the Press, and by lectures and addresses, have been no less remarkable, stimulated as all this interest has been by the holding of the Exhibition in Chicago, in 1892–93, for, wonderful as were the revelations of the Centennial, to the public of 1876, the marvellous showing of the Columbian Exhibition, or World's Fair, at Chicago, in 1892–93, completely overshadowed them.

In this later Exhibition of the World's Industries and Arts, was shown not only the striking advances made since 1873, by all the world, in every field of Human Activity, Knowledge and Enterprise, in Art and Industry; but, also, more impressive if possible,—at any rate more significant educationally,—than these myriad treasures from all the earth, was the revelation of the marvellous beauty of that White City by the Inland Sea; with its classic Peristyle, worthy of the Athens of Pericles and Phidias; its lofty pillared fronts and swelling domes,—its vast palaces, stretching in seeming endless procession. The beautiful treasure-houses America had built for the world's richest offerings! These stately structures, which filled every beholder with wonder and delight, proclaimed to the world that, in the intervening years following the Centennial, the Young Nation of the West had given birth to a race of great Builders—Architects, Sculptors, Painters and Decorators, worthy to rank with the world's worthiest!

As the American Architects had, as a body, early undertaken to secure thorough training in that art, for the young men aspiring to enter their profession; this demonstration of the grand results of thorough artistic training in Architecture and its kindred Arts, was in the nature of a triumphal verdict in favor of definite education,—of special training—in Art, as well as in Science, or in the so called "Learned Professions."

Thus, while these temporary buildings by their variety, fitness and beauty of proportion, won the admiration of all beholders; they were, in fact, but a great object lesson, illustrating on a gigantic scale, what Education in Architecture, Art, and Artistic Decoration, could effect.

The noble building of the Boston Public Library, since erected, and the stately marble palace of the National Library, so recently opened in Washington, are enduring monuments; showing what the art of American Architects, Builders, Sculptors and Painters, can accomplish, in these closing years of the Nineteenth Century, in the construction and adornment of a great public building.

The exterior walls and sculptures of the National Library, the interior halls and grand stairways, and, above all, the profusion, variety and general excellence of the sculptured and pictorial art works enriching walls and ceilings within, remind us that we are, even now, in this Nineteenth Century, living in the years of that "Renaissance" which did not pass away, as we once thought, with the passing of Angelo, Raphael, Da Vinci, and their Peers, but which is still vital with inspiration; so that here, on this to them unknown continent, opportunities are beginning for the future Art Masters of the world. When Hunt, painted his two great allegorical pictures on the walls of the Legislative Chamber in the State Capitol at Albany, that great artist "builded better than he knew,"—though alas! his own works so quickly passed,—for by that single precedent he opened up all wall spaces of public buildings to the future artists of America; so that hereafter, in this land, it shall be held, just as it was in Europe centuries ago, that the walls and ceilings of all palaces, churches, and other public buildings are to be considered but as the durable canvases of the Painters.

That "Re-birth" of the Past, which came with the discovery of a few of the Art wonders of Greece, occurring almost simultaneously with the regaining of some of the intellectual glories of Greece and Rome, in the unearthing of a few manuscripts; which gave to us moderns a glimpse of their glorious intellectual triumphs,—as yet unsurpassed and seemingly unsurpassable—gave to our conception of the capacity of the Human Intellect a new Ideal, and woke the World to Life!

What the wonders of the Classic Age, in Art and Literature, must have been, we can faintly imagine contemplating the works of the intellectual and artistic giants of Italy in the middle ages, who sprang into being at the magic call of a few scattered fragments of the words and works of the Mightier Ancients; just as, in Holy Writ, we are told the chance touch of the bones of the Prophet Elisha, woke the dead to life!

So, to day, as Homer, Æschylus, Demosthenes, Aristotle and Plato, dominate the world of Letters in Poetry, Eloquence and Philosophy; Phidias, Ictinus, Apelles, and their compeers, lead the worshipers of Art.

In Art, in our own day, have been repeated similar discoveries to those which in Literature, four centuries ago, aroused to new activities the mind of Europe; for the revelations of Etruscan tombs, the patient explorations by Layard, Schliemann and Di Cesnola, the unearthing of the terra cotta figurines in Tanagra, the later work by English and American enthusiastic scholars in Greece, in these very days, have brought home to us moderns a comprehension of the vitality of classic art, which, contrary to our earlier impressions, we now find to have been busied not only with the ideal images of the Olympian Divinities, but also, with the every day life of the people, all testifying to the solidarity of the Human Race; for, quickened by the life-giving touch of their artists in those far off centuries, the little figurines of the graceful maidens of Tanagra, reveal, in their unconscious attitudes, the same love of dress, the same delight in free movement and flowing robes, in short, the same irrepressible joy in Life, and the same marvelous beauty of youth, which meets us to-day on every hand, a-foot or a-wheel, in the blushing maidens of 16 years in this fair land, the unknown "Ultima Thule" of the Ancients! So Past and Present meet and blend, taking no thought of the thousand intervening years. Here to-day, the Thought, the Art, of Athens and Rome, shape our thoughts and arts; so that we, consciously or unconsciously, are the children of that elder civilization.

The most recent illustration of this influence of classic examples upon our modern American art ideals, to which reference has been made, occurs among the Buildings of the Exposition held in Nashville, Tennessee, in this summer of 1897—where the crowning architectural charm is found in the striking restoration of the Parthenon of Athens, which is the model taken for the Art Building of the Exposition. This reproduction is spoken of as full of grandeur and beauty.

It is also remarked that the Government Building erected for showing the Governmental Exhibits, has, fortunately, been modelled after the Chicago Exhibition Art Building; so that, instead of being externally, as was the one at Chicago, a hideous enormity, in

contrast with the artistic buildings surrounding it,—this copy, in little, of the beautiful construction designed by Richard M. Hunt, for the Art Building of Chicago, is not out of harmony even when brought into contrast with the world renowned chef d'œuvre of Ictinus and Phidias.

This is all the more to be rejoiced in, because it began to seem that, under the stress for room in our modern cities, all ideas of beauty in Architecture; must, perforce, be wholly subordinated to the frenzy of piling stories upon stories, till the builders seemed to have no ideal other than that of the Tower of Babel!

This epidemic of many storied buildings has had a most unfortunate effect, in many instances, in degrading the architectural aspect of our older cities. Perhaps, some of the most striking examples of this incidental evil, are to be found in the City of New York; where the ever beautiful old familiar land-mark of Trinity Church Steeple, has been eliminated from the once attractive view of the City, as seen from the Bay. In addition to this misfortune, must be reckoned the recent belittling of that charming example of palace architecture, the New York City Hall, formerly so well shown, standing as it did in the ample open square given to it in the heart of the town; now, seeming as if at the bottom of some mountain valley, towered over by the clustering cliff-like business buildings that crowd about the Square, shutting out all view save of their own precipitous walls.

In Washington, an impertinent modern apartment house, towering in apparent emulation of the Washington Monument, obtrudes its awkward outlines and gigantic bulk, in every possible view of the Capital City, once so beautiful as seen from every point of vantage, and uglifies it all.

In some, at least, of the cities of Europe, the observer can hardly fail to notice that, while the residences and business buildings in the streets of the city may make no pretence to any display of architecture,—often being noticeable rather by reason of excessive plainness—care has been taken to secure for the public buildings of Church, or State,—the Cathedral and the Civic Palace,—ample Space; where no private erections could ever destroy the harmony of proportion, or impair the true architectural effect of the building.

In this country, notably in the very instance of the New York City Hall, this effect was supposedly secured by the generation who

built it; only to be thrown away by a later generation of ignoble, or careless, successors.

In the situation of the Capitol Building of the United States, in Washington, D. C., and in those of the State Capitol buildings in Albany, New York; in Boston, Massachusetts; in Hartford, Connecticut; in Nashville, Tennessee; and in many another State Capital, the sites are commanding.

It is to be hoped that in the choice of the situation of the new buildings of Columbia College, and the new Cathedral, in Morningside Heights, New York, the relative position of those several buildings have been so chosen as to be architecturally isolated; so that no such misfortunes can affect them, as have recently relegated Trinity Church, and the City Hall, to comparative obscurity.

If, hereafter, American towns and cities, take pains to secure ample room and effective position for their chief architectural buildings, the lesson to be learned from the humiliating experience, architecturally, of New York City, may not be without compensation.

In a Republic, it seems eminently wise that the powerful effects of Great Architecture should be reserved for the Public Buildings of Church and State, rather than be lavished on the comparatively humble dwellings of private citizens, however wealthy, or personally powerful, they may chance to be; for the individual passes, but the State remains.

In a country like ours, where, fortunately, there is no hereditary class, it is absolutely wasteful for any private citizens to build palaces for their residences, only to leave them to be enjoyed by strangers; as has been, and seemingly must continue to be, the history of many of the costly private dwellings built by ostentatious millionaires in the United States, during the past few decades.

It is well that this should be so. Great Art is for All the People and can no more be limited to a few, than can the blessed sunlight; which floods alike the hut of the hind, and the palace of the noble.

The present volume of this Report, as well as the one immediately preceding, is mainly given rather to a consideration of the opportunities afforded in these United States, for acquiring Technical Industrial and Scientific Training, than to the facilities for acquiring knowledge of, and skill in, the so called Fine Arts; though, in view of the intimate connection which exists between the Industrial and Fine Arts, and of the fact that much of the Elementary Training is

essentially the same in both, the consideration of either is in place in each and every volume of this Report; though the given volume may be mostly occupied with the other. It is with this thought that the foregoing pages have been given to the brief summary of the recent remarkable development of the Fine and Decorative Arts, in connection with the forward movement in the Architecture of Public Buildings; so strikingly illustrated in the recently erected Library Buildings, in Boston and Washington. The just completed building of the Chicago Public Library, though on a smaller scale than the others, and, in further contrast, making larger use of merely decorative marbles in wall surfaces than of the work of the artist painters; is, nevertheless, unmistakably of the Renaissance Period.

The wonderful wealth in decorative carvings and grandiose stairways in the as yet uncompleted State Capitol at Albany, suggests some of the undesirable features of the later Renaissance, in which, in the interiors, costliness of material and work, seemed to take the place of artistic inspiration; while the ostentatious piling up of costly stone exteriors, suffocated all efforts of living Art. A heathen apotheosis of mere material wealth, against which Gothic Art was a religious protest; and concerning which, John Ruskin, has so earnestly and eloquently warned the men of his own day. Coldly inhuman, these towering piles of quarried stone frowning above our City streets, seem as menacing as hostile fortresses.

The grand marble stairway, of the Capitol Building in Albany, designed by Richardson, and said to be the most beautiful and costly example of elaborate carved work in the country, which has taken more than twelve years in its construction, seems to repeat, in the lavish profusion of its carving, something of the extravagance of the later Renaissance. It is due, however, to the architects of this great building,—Messrs. Fuller, Eidlitez, and H. H. Richardson, to state that its exterior in no wise recalls the characteristics of those ostentatious buildings referred to; while it is well to remember that, if anywhere, profusion of art decoration is fitly employed, it is in enriching and dignifying the important public buildings designed for the uses of the people. In considering this particular People's palace, all who love Art, must ever remember that it was in this building, as has already been here stated, that William M. Hunt, the great Painter, set to the American Artists

and Builders of our time, the striking lesson of noble Art Decoration so fortunately followed in the great Public Library Buildings just completed.

In the zeal of this new awakening on the part of American Architects and their employers, to a practical recognition of the value of Art in the decoration of the interior wall surfaces of public buildings,—the most recent examples of which I have instanced,—it should not be forgotten, that, decades before these later buildings were planned, those who had charge of the construction of the grand building of the Nation's Capitol in Washington, had freely availed themselves of the works of the American Painters of their day, beginning as early as 1837, to illustrate memorable and pivotal events in the history of the Republic; so that, on entering the grand Rotunda, the visitors found themselves encircled by a series of large historical paintings, of a size in harmony with the colossal proportions of the encircling walls which supported the upspringing arches of the crowning Dome; while in the Dome itself, in a blaze of Allegory, dear to the heart of Italy, was given the Italian Artist's conception both of the great Powers essential to the prosperity of a People, and, though diplomatically disguised in appellation, a glimpse of the crowning triumph of the Nation in its latest terrible struggle for existence. From the landing of Columbus to the coming of Lincoln,—he who runs may read; in the Paintings, the Bas-reliefs and the encircling Frieze, "*in tempera*,"—(though little can be said in praise of the artistic excellence of the relievos and the frieze)—the dramatic events of the Centuries which have resulted in giving to the world, the Republic of these United States of America.

Our Legislators, called not only on the Painters, but also summoned the Sculptors, to the adornment of this, the chief building of their Country, and gradually, important works by Greenough, Powers, Crawford, and Rogers, were secured. In addition to these works by native artists, the services of Italian artists, as decorators, were largely availed of in the halls, galleries and committee rooms, of the building; while in the wings, occupied respectively, by the Legislative Chambers of the House of Representatives and the Senate, later American Artists have added many fine works illustrating the history, or the scenery, of the Country.

It has been a fashion with many writers, posing as art-critics, to

speak contemptuously of the historical paintings in the Rotunda. However true their criticism may have been, if comparison of these paintings with the chef d'oeuvres of the worlds great Artists,—Titian, Tintoretto, Veronese, Velasquez, Rubens, and other Great Art Masters in Historical Painting, either in their conception of the subject or mastery of technique, are concerned; it should not be forgotten, in endeavoring to estimate the value of this art work to the country, that, a half century or more ago, few American citizens who entered that building had ever before had the opportunity to look upon a fine work of art of any kind. It followed, therefore, that the sight of that grand Rotunda, with its uplifting Dome, its great Paintings, was an event never to be forgotten; and the grandeur and inspiration of the scene gave to many their first realization of the meaning, the power, and the possibilities of Art.

There have been American Artists, before and since these works were painted, who justly rank as artists far in advance of Trumbull, (though few have left works which can surpass in brilliancy his small jewel-like originals of these large paintings, long the pride of the Yale College Art Gallery) Weir, Chapman, Vanderlyn, and Powell, the painters of the works in the Rotunda; but it may well be questioned whether, before 1870, any other American Artists have given to so many of their fellow countrymen their first appreciation of something of the glory of Art!

A debt of gratitude is due to the Legislators who authorised and the Artists who executed those works.

Nor, taken as a whole, are the art adornments of this, the noblest Legislative building in the world, inferior to those of similar modern public buildings in European Countries. Art in the early part of the Nineteenth Century, so far as shown in statuary on the exterior of buildings, was in no wise generally superior to the grandiose sculptures by Persico, which stand in the East Portico of the Rotunda; while the group by Greenough, is far superior to the ordinary statuary of that day. Nor, in painting, was Trumbull, so greatly inferior to his Master, West! In fact, the era of the Reign of the Fourth George of England, was, nowhere in Europe, memorable as illustrating the highest ideals of Art. Early in this century America had in Allston, and Stuart, Art Masters equal to their contemporaries of any other nations.

In view of this long-continued example of the possibilities of the

artistic use of interior wall surfaces, as shown by the pictorial illustrations, in the Rotunda, of the history of the country, by well-known Artists; and, also, by decorative paintings on minor wall spaces, which adorn the interiors of the Nation's Capitol building; the fact of the almost entire absence throughout this period of similar wall paintings and decorations in other civic public buildings in the land, as well as in churches, and private dwellings, so that the paintings by Hunt, in the State House, at Albany, can be accurately designated as marking the definite beginning of the present era of the general artistic interior decoration of buildings, civic and religious, public and private;—furnishes a convincing proof of the utter lack, on the part of the American people as a whole, of any general knowledge and appreciation of the value of Art in its application to the buildings, and the furnishings, of life, prior to the holding of the Centennial Exposition in Philadelphia, in 1876.

It may well be urged that, up to that time, this busy people were too fully occupied in completing the physical conquest of a vast territory, in subduing forests, bridging streams and opening virgin prairies to cultivation; in providing for the transportation, the housing, and feeding of the ever surging incoming tides of eager emigrants; were in short too busy in their imperative task of *making* History; to find time, or thought, for its artistic record! When, at last, they found time to pause and study the lessons of the Centennial, they proved apt students; as the Columbian Exposition has shown!

Yet notwithstanding this later surprising and artistic evolution of the American people, so wide spread and rapid has been the development of Technical Training in its application to Industrial and Fine Art Manufactures throughout the leading countries of the continent of Europe, and also, though begun later, in Great Britain, that, although the development in elementary artistic training and in facilities for the acquisition of advanced instruction in these arts, in the United States, has been wonderfully increased since the beginning in Boston, in 1870, of the movement for school instruction in Drawing, and the holding of the Centennial Exposition in Philadelphia, in 1876; still, in the opportunities offered for the training of skilled youthful workers in the industries of applied art, the United States, to day,—in view of the persistent efforts and great advances made during the past twenty years, by European countries, in providing such educational facilities,—are, relatively,

hardly in any better position to contest successfully with the products of the trained workers of Europe, than they were in 1870.

Nevertheless the efforts made in this country by leading educators, and by liberal patrons of artistic and technical education, have been notable, and most worthy of honor; while the great advance since the Centennial, as shown in the art qualities of American manufactures, in furniture, in jewelry, in glass, in art-fabrics in silk, in woolen and in cotton, as well as in Architecture, and in all material pertaining to the Decorative Arts, has been simply marvellous.

So far, also, as affording requisite opportunities for acquiring thorough training in the Fine Arts of Painting, Sculpture, and Architecture, the few Art Schools in the United States, compare most favorably with those of the older countries; so that it is no longer essential,—though it may often be, for other reasons, desirable,—for the ambitious young painter, sculptor, or architect, to exile himself in order to obtain needed opportunities for instruction in those several arts. Nor are our leading Technical Schools of Science, inferior in equipment, or in quality of instruction, to the similar schools in Europe. These schools in the United States are, however, so few in number in proportion to our increasing population, as compared to the number and variety of those offered to the citizens of the leading Art Industrial European Countries of Germany, Switzerland, Belgium and France,—not to mention Great Britain, Austria, Italy and Russia,—that the inadequacy in numbers of our schools for training the Captains of Industry, not to mention those merely technical trade schools designed for creating a force of trained workers,—impresses itself painfully upon the investigator in these fields.

With the increasing knowledge of the forces of Nature acquired by the patient investigations continually carried on by Scientists of every class:—in Chemistry, in Geology, in Natural Philosophy, in Mining, both in the methods of mechanical operations, and in the reduction of ores; in short, in the general application of the discoveries of Science throughout the various realms of Nature, to the needs of Man, which so constantly revolutionize former methods and create ever new demands; for example in the endeavor to secure the economic production of electricity and to contrive the best methods for its application to human uses—not to speak of the

similar needs in other fields; the demand on the community for the founding of institutions forgiving thorough training in these latest discoveries of Science, is imperative.

In all these ever recurring demands for the invention and application of methods by which to make these discoveries of Science available in the industries of life, a knowledge of, and practical facility, in the art of "Mechanical Drawing" becomes absolutely indispensable; consequently, this elementary branch of industrial art clearly forms an essential factor in modern industrial education, and, of necessity, holds place in all the elementary and higher Schools of Technology; hence, though its relation to the so called "High Arts," may at times seem somewhat remote, its claim to a place in this Report on Art and Industry, is unquestionable.

Even in so large a work as the present Report, it is not possible to give an extended description, in detail, of the several schools included in its survey; so that the accounts here given must needs be limited to those departments, of the U. S. Land Grant Colleges, and other Institutions, in which Industrial Drawing, Mechanical and other, is taught; these accounts could not with propriety be omitted and to them the present volume is mostly given. Full accounts of these U. S. Colleges, in all their departments, are given in other publications of the U. S. Bureau of Education, as well as in the catalogues of each institution; so that those wishing fuller information concerning the several institutions can readily find access to the original sources.

In the Appendices to each of the previous volumes of this Report, accounts are given of many of the Technical Schools, provided for giving instruction in the Arts and Industries, in the leading countries of Europe; with some account of the Methods adopted by the Several Governments for promoting such Elementary and advanced Technical Training.

These Accounts and Official Reports, show how earnest and continuous have been the efforts in these countries to train their citizens in such a manner as would enable them to take advantage of the discoveries of the Scientific Investigators as they occur.

In Part I., much space was given to a showing of the methods made use of in Great Britain; while copious excerpts, giving a concise summary of their contents, were given from the Thirtieth, Thirty First, and Thirty Second, Annual "Reports of the Science

and Art Department." 1882–1885. (See Part I. Appendix F. pages 709–793.)

As already clearly set forth, much of the material comprised in these two latest volumes of this Report on Art and Industry,—"Parts III. and IV."—had been long ready for publication; and it was in order to bring the account of the movement in the United States, down to the present time, that the final comprehensive Appendix W. (pages 903–1116) was added to volume III. As these two volumes are to appear almost simultaneously, it was thought expedient to include all this material essential to an intelligent view of the present status of Industrial Art Education in the United States, in Part III.; and not to add this material to the Appendices of Part IV.*

It happens, however, that just as the present volume is about to go to press, the Forty Fourth Annual Report of the Department

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*The issue of Volume 2, of the Annual Report of the U. S. Commissioner of Education for 1895–'96, at this time, (November, 1897) permits reference here to severa articles in that volume likely to be valued by those interested in the topics treated in this Special Report on Art and Industry.

The articles furnished by the Specialists of the Bureau to these Annual Reports, in which the current statistics of the several institutions are collated; will be found of value, as showing the development and contemporary condition of various educational experiments, as well as the status of long established methods and schools.

The Annual Reports of the U. S. Commissioner of Education, owing to their frequency of publication, and their accessibility due to their larger editions, effectually supplement, and give additional value to, the occasional Special Reports issued by the Bureau, by bringing the several histories contained in the latter, down to the date of the Annual Issues; and are, therefore, of value to the student of the par ticular topics treated in these Special Reports. In the present work, the author has sought, in each volume, to include the latest information possible; and, also, to indicate the purpose of the whole work, for the benefit of those who may not have access to all the "Parts" of this particular Report, or to the volumes of the Annual Reports. The statistics of the latter, however, should be consulted by those who desire the fullest and latest information.

In this latest volume of the Annual Reports (Vol. 2, of 1895–'96) just referred to, Chapter XXI, on "Manual and Industrial Educational Institutions," prepared by Mr. James C. Boykin; Chapter XXV, on "Industrial Education in Central Europe;" Chapter XXVII, on "U. S. Colleges of Agriculture and the Mechanic Arts," compiled by Mr. Wellford Addis; Chapter XXIX, on "Current Discussions;" in which several well-known authorities on Art and Industry take part; and Chapter XXXI, on "Art Decoration in School Houses;" compiled by Dr. Stephen B. Weeks, will be found of value and interest, and are commended to the readers of the present Special Report.

I. E. C.

of Science and Art, for 1896, (London 1897,) is received. As a somewhat exhaustive summary of the various Governmental Schools, Museums, and methods of aiding private schools in Great Britain, has already been given in Part I. of the present Art and Industry Report, further space cannot be here given to these details. This 44th Report, however, contains an important Special Report on the latest development of Technical Education in Germany, made by a board of Commissioners, comprising some of the leading English Authorities on Technical Education; which so fully confirms the statement just made, in this "Introduction", concerning the greater relative activity,—as compared with the United States,—of the leading European Countries, in the promotion of such special training, that I am gratified to be able to include it in the additional Appendix "C C.," to this volume. It seems to show, also, that during the past decade, these European Nations have not slackened in their educational activities in these practical directions.

The papers in the other Appendices, which relate to the English Educational Efforts, bear date, some of them, of ten years previous; they show that, at that time, the leading educators of England, were fully awake to the value of the definite technical industrial artistic training of their people.

The growing competition of German Manufacturers with those of Great Britain, during the last decade, has stimulated increased interest in this phase of Education; for the words "Made in Germany," which the law compels to appear on all such goods, have revealed to the British public the dangerous inroads made by German manufacturers on the home market in England.

In view of this condition in the English Markets, and in consideration of the world-contest now waging for commercial supremacy, the people of the United States are no less concerned to know what other Nations are doing in relation to this matter of definite technical education, than they are anxious to be informed of the efforts made by Great Britain. It is for this reason, that this authoritative expert Report on German Technical Industrial and Artistic Education, is here introduced, and earnestly commended, to the thoughtful consideration of American Educators, Manufacturers, and Statesmen.

ORDER OF CHAPTERS AND APPENDICES.

This volume comprises a brief Introduction—Fourteen Chapters descriptive of the Institutions affording Technical Training; and a series of six Appendices, Lettered from "X" to "C C" inclusive, containing various papers, addresses, and reports, relating to Technical Industrial Training in the United States, and in several of the Countries of Europe.

Chapter I., (pages 3–8) is introductory, giving a general view of the plan of the volume with an analysis of its contents, and defining the several groups of schools, into which the various Institutions in the United States devoted to Technical Industrial Education may be divided.

Chapter II., (pages 9–78) Treats of the "Primary Group,"—The Manual Training Schools proper. The two pioneer schools of Boston, and St. Louis, The Spring Garden Institute, of Philadelphia, and the Chicago Manual Training School, are the schools described.

Chapter III., (pages 79–106) Describes the instruction in Manual Training and in Drawing, given in the Preparatory Schools and in the Colleges, of the Tulane University, New Orleans, Louisiana. A concise statement is also given of the founding of this noble benefaction by the late Mr. Tulane, of the part taken by the late Hon. Randall Lee Gibson, U. S. S. from Louisiana, and of the successful development of the institution under the wise direction of President William Preston Johnston, and the Board of Trustees.

Chapter IV., (pages 107–128) Describes two special Technical Trade Schools and includes the report, made by a special committee, to the Annual Convention of the National Carriage-Builders' Association, held in New Haven, Connecticut in 1883; with a summary of the interesting discussion which followed, as to the kind and amount of practical industrial education for boys, which it is possible to give in the Public Schools.

Chapter V., (pages 129–170) Describes a most interesting experiment in Technical Trade Education, undertaken at Mt. Clare Station, near Baltimore, by the B. & O. R. R. Corporation, under the Presidency of Robert Garrett; with extracts from the valuable report made to President Garrett, by his assistant the late Dr. W. T. Barnard.

Chapter VI., (pages 171–223) contains accounts of five notable Technical Mechanical Schools. These are The Worcester Free

Institute, Worcester, Massachusetts; The Rose Polytechnic Institute, Terre Haute, Indiana; The University of Illinois, Urbana, Illinois; The Sibley College of Mechanic Arts, Cornell University, Ithaca, New York; and The College of Mechanics, University of California, Berkeley, California.

Chapter VII., (pages 225–232) Introduces the accounts of the several Colleges of Agriculture and The Mechanic Arts, endowed by the National Land Grant Law of 1862.

Chapters VIII., to XIV., inclusive (pages 233–657), contain such accounts of the Technical Industrial Departments, of the several "Land Grant Colleges of Agriculture and the Mechanic Arts," as are germane to the purpose of this Special Report.

CONTENTS AND ARRANGEMENT OF APPENDICES.

APPENDICES (pages 707–991) A brief general Introduction, descriptive of the contents of the several appendices precedes the opening Appendix.

APPENDIX X., (pages 711–940) contains papers relating to Technical Education in the United States; with instances of similar efforts in European Countries; and is composed of the several addresses, by leading American Educators, delivered on the occasion of the formal opening of Rose Polytechnic Institute, Terre Haute, Indiana, in 1883; of the Inaugural Address on that occasion, by President Thompson; and by an Inaugural Address delivered on a similar occasion, by President Homer T. Fuller, at the Worcester Free Institute, Worcester, Massachusetts, also in 1883. These addresses by Presidents Thompson, and Fuller, are most valuable contributions to the literature of this new movement in American Education.

APPENDIX Y., (pages 741–833) This Appendix, contains most of the valuable report made on the subject of Technical Industrial Education, by the late lamented Dr. W. T. Barnard, to President Robert Garrett, of the B. & O. R. R. Co. in 1886. This is, in itself, a most valuable and suggestive treatment of the subject; while the accounts which accompany it, of the several Technical Institutions in Europe, give it additional value for this volume.

APPENDIX Z., (pages 835–891) contains papers relating especially to the U. S. Land Grant Colleges. First: are verbatim copies of the three Laws enacted concerning them;—the acts of 1862—of 1887 and of 1890. These are followed by interesting historical statements

concerning the passage of the initial act of 1862, with an account of the efforts to promote the passage of the Act, so successfully rendered by the Rev. Amos Brown, of the State of New York; and by Dr. Evan Pugh, of the State of Pennsylvania.

It is hardly too much to assert, to say that this Act, popularly known as "The Morrill Act," from the service rendered, and the successful passage finally effected, by the energetic and intelligent efforts of the Hon. Justin S. Morrill,—then a Member of Congress from Vermont; and still, at the present time, as for many years past, the senior Senator from that State;—has proved to have been one of the most important enactments—in its far-reaching influence on Education,—ever passed by the Congress of the United States.

These historical statements relating to the passage of the Act, are followed by a report of the Commemorative Addresses, delivered in 1887, at the Agricultural College, in Amherst, on the 25th Anniversary of the passage of the Law.

A paper by Professor R. B. Warder, on "Agricultural Education in Bavaria", follows. Two addresses close this Appendix. One on "Technical Training", by Professor John Hamilton, delivered on the opening of a new Mechanical Department of Pennsylvania State College, in 1886; and The Farewell Address by Bishop Haygood, at the Commencement of Claflin College, South Carolina, in 1890. This admirable address, in which the relations of the colored people to the community, and the kind of education most needed by them, are frankly stated, is well worth the careful consideration of all who are in any way interested in the race problem as it presents itself in the United States. The following statement quoted in the New York Tribune, of August 25th, 1897, bears witness to the excellent results of that "Industrial Training" which the good Bishop so heartily endorses.

"According to "The Atlanta Chronicle," negroes in the South are rapidly filling the trades. As carpenters, bricklayers, plasterers, blacksmiths and wheelwrights they are growing more and more numerous, and making it difficult for white men to prosper in these fields of labor. "A glance at the white schools and the negro schools of the South," adds "The Chronicle," "will show that the negro schools are teaching their pupils more of the practical needs of life, and fitting them to earn a livelihood better than the white schools are. For every white technological school the negroes have half a dozen with technological and industrial features. Every year young men are being turned out of the negro schools in the South who have been taught carpentry, blacksmithing, printing, the general use of tools and scientific farming, in addition to the usual academic courses, and young women

who are taught cooking, washing, sewing, dressmaking, nursing and housekeeping. When a young negro man or woman leaves any one of more than a dozen schools in the South he or she is equipped for earning a livelihood and for advancing the standard of the race. Our people need arousing to the importance of technological and industrial education. We want educated hands as well as educated heads."

By happy chance the next day's issue of the Tribune ,(August 26th 1897) announced, in its "Personal" column, the fact that the French Government had purchased for the Gallery of the Luxembourg, an important painting, "The Raising of Lazarus", the work of a colored American; who, formerly an instructor in drawing in Fisk University, Nashville, Tennessee, became later a pupil of Benjamin Constant, the great French Artist in Paris; and has now won this eagerly sought recognition conferred by the Government Authorities of France. The name of this successful American artist is Henry O. Tanner, a son of Bishop Tanner, formerly of Philadelphia, but now of Kansas City, Missouri. As this Report is given to an account of the development of the Industrial and Fine Arts in the United States, I have thought these two statements well worthy of mention in this introduction; as showing that, both in Industry and the Fine Arts, our African fellow citizens are proving their fitness for thorough education in the industries and the arts.*

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*In Part II. of this Report, will be found reference to the industrial features so desirable in the education of the Colored Race, in connection with an account of an exhibition of the Manual Training School Work of the Colored Schools of Washington, D. C. (See Part II Pages 246–249) This important question as to the form of industrial education best adapted to the needs of the colored pupils, is considered at some length in a recent Report by the U. S. Commissioner of Education. (See Report for 1894–95, Vol. 2, Chapters XXXI and XXXII.—pages 1331–1424.) The first of these chapters is prefaced by references to the preceding publications of this Bureau, in which the topic of the education of the colored people is treated. These comprise most of the "Annual Reports," beginning with that of 1870; five special "Circulars of Information," issued from 1883 to '92; the Special Report on District of Columbia, in 1869, and the Special Report on The New Orleans Exposition, in 1884–85. Several tables containing summaries of statistics, are given in Chapter XXXI., of the Report for 1894–95; followed by a table, filling 17 pages with detailed statistics of one hundred and sixty two "Schools for the Education of the Colored Race." This chapter closes with two notable addresses. The first, by that leading educator, Principal Booker T. Washington, of the Tuskegee, Alabama, Normal and Industrial Institute, was delivered at the "Alexander Hamilton, Commemoration Dinner," in Brooklyn, N. Y., in January, 1896. The subject was "The Industrial Education of the Blacks." The second, by President E. C. Mitchell, of Leland University, New Orleans, La., was given before the American Baptist

APPENDIX A A., (pages 893–916) comprises "Papers relating to Technical Education in England" As each Appendix, and also each paper quoted, is preceded by an introduction, no special attempt is made in this general introduction to go into minute details, since in all cases the several introductions may be consulted.

The four papers here given are fully summarized in the introduction to this Appendix. They treat of Technical Instruction in Elementary Schools, Board Schools, and Technical Schools. Addresses by the Lord Chancellor, and by the Prince of Wales, on the occasion of the Opening of "The City and Guilds of London Institute," furnish proof of the extraordinary interest shown in Great Britain, in the development and encouragement of Technical Training. If this is of so great importance to the English people, may it not be of some consequence to Americans, in the rapidly increasing world competition for industrial supremacy?

APPENDIX B B., (pages 917–944) "Papers Relating to Technical Art Training in England." These papers continue the discussion of the topics of those in the previous Appendix, and enlarge upon the importance of art qualities in manufactures.

The two opening papers are from leading Press Authorities; The London Times, and The Westminster Review. There is, also, an Official Statement of the Purpose of "The National Association for The Promotion of Technical Education in Great Britain", followed by an address, by Professor Huxley, on "The Vital Importance of Technical Education to Great Britain."

APPENDIX C C., (pages 945–991) Papers relating to the present status of Technical and Industrial Art Education in Great Britain, and in Germany, in 1896–1897.

These include, first: Miscellaneous extracts from public journals concerning a new movement for promoting the development of

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Home Mission Society, at Asbury Park, N. J., May 26, 1896. His subject was "Higher Education and the Negro." (For these two addresses, see pages 1356–1366). Chapter XXXII., is given to an authoritative exposition of the workings of The Slater Fund in the Education of the Negro. (See pages 1367–1424.)

In the Annual Report of the U. S. Commissioner of Education, for 1893–94, is a lengthy Statistical Table of Schools of Manual Training, etc., a table published only at intervals of five years. (See Vol. 2, pages 2093–2169.) In this table—which includes eleven different classes of institutions, besides City Public Schools—are given the statistics of Sixty three "Manual Training Schools for the Colored Race," in which is an attendance of nearly eight thousand pupils. (See pages 2118–2122.)

Manual Training in the Board Schools of London, undertaken during the autumn of 1897, followed by a notice of an educational meeting for the promotion of Sloyd, held in Manchester; with brief accounts of municipal instruction in Art and Technology in Manchester, and an item concerning Free Scholarships in London. Then follow notices of the addresses delivered on the opening of Technical Institutions in Great Britain, as follows:

At the new Technical Schools in Middlewich, by Sir John Brunner; at the Royal Technical Institute, at Salford, by Mr. William Mather; another address by Mr. Mather, on the occasion of the anniversary of a Technical School at Stockport; in which he calls attention to the fact that American youth enjoy a longer elementary training than do the youth of England.

An address by Sir John Lubbock, M. P., at the anniversary of the Stalybridge Technical School, October 22nd, 1897.

An address by Sir William H. Bailey, on the occasion of the distribution of prizes to the Student prize winners of the Hindley Technical Schools, October 20th, 1897.

An address on "The Importance of Education in Science," delivered by the Duke of Devonshire, on the occasion of the opening of the new Technical College at Darlington, October 8th, 1897. A summary of an address on Technical Education, delivered by the Bishop of London, at the opening of New Technical and Art Schools, by the corporation of Leicester, October 5th, 1897, follows. Reference is made to the address by the Earl of Crewe, at the opening of the New Technical Institute at Crewe, October 16th, 1897. This is followed by an address by the Earl of Derby, on the occasion of the inauguration of the New Technical School at Preston, founded by the trustees of the late Mr. E. R. Harris, as a memorial of the Queen's Jubilee, and opened personally by the Countess of Derby.

Then several addresses witness to the active interest taken, in the promotion of Technical Education in the industries and arts, by leading English Statesmen.

Two interesting papers from the files of the New York Tribune, which follow: Show both the English and the German estimate of the importance of definite Technical Training in Industries.

These miscellaneous reports and articles are followed by a brief summary of the contents of the 44th official report of the Department of Science and Art. (London 1897.) This abstract of the Gov-

ernmen Statistical Report precedes a valuable special Report on "The Recent Progress of Technical Education in Germany," made to the Government of Great Britain by the Technical Industrial Commissioners; with a Supplementary account of special Technical Educational Institutions in Germany, and with accounts of several local German Industrial and Art Exhibitions.

TECHNICAL INDUSTRIAL TRAINING.

1

CHAPTER I.

INSTITUTIONS AFFORDING TECHNICAL INDUSTRIAL TRAINING. INTRODUCTORY CHAPTER DEFINING THE ORDER IN WHICH THE INSTITUTIONS ARE GROUPED.

The plan of the chapters immediately succeeding—(1) The Typical Manual Training Schools—(2) Schools, in connection with the Technical Industrial Schools—(3) The Schools of Science and Engineering, and the Land Grant Colleges—These classes of schools form a well-defined series of Institutions:—The "Primary Group" comprises The Boston, St. Louis, Spring Garden (Philadelphia), the Chicago and the Tulane University Manual Training Schools—The School for Carriage draughting, in connection with the Schools of the Metropolitan Museum is in 1883, the one Trade School—The Worcester Free Institute, and the Mechanical Engineering Schools of Illinois University, Rose Polytechnic Institute, Cornell University, University of California, and the Mechanical Departments of the Land Grant Colleges, form another group—while the higher Schools of Science form still another—The schools of Technical Design fall under a different class and are related rather to the schools of the Fine Arts than to those of Manual Training—Reasons given for grouping these latter schools in the following volume with the schools of the Fine Arts—The Revue des Deux Mondes quoted as recognizing the interblending of all the Arts and Industries.

INSTITUTIONS AFFORDING TECHNICAL INDUSTRIAL EDUCATION.

The new elementary industrial schools of Mechanical manipulation, so often referred to in the preceding volume in connection with a consideration of the proposed changes in, or additions to, the studies taught in public schools,—are here grouped with schools of "Technical Education in Industrial Art," the higher "Schools of Engineering," and "The Colleges of Agriculture and The Mechanic Arts," to which they may be considered as preliminary; for, taken altogether, these form a comprehensive class of institutions which, in themselves, comprise and embody the educational facilities afforded in the United States, for obtaining a knowledge of the theory and practice of the scientific professions, as distinguished from the merely literary, and general, the "learned professions," as they have been so long called; or, on the other hand, the artistic, callings.

These are the schools, academies and universities, of Applied Science;—the reservoirs of scientific learning upon which the country is to depend for the educated brain power and trained technical skill, essential to the full development of its material resources.

As we have seen that a knowledge of drawing is at the basis of all

scientific construction, and of all artistic manufactures, it follows that, so far as their courses of instruction in drawing are included, these institutions come properly within the scope of this Report. Accounts of the other departments of the colleges, etc., will be found recorded in other publications of this Bureau.*

The primary group comprises

(1.) The School of Mechanic Arts of the Massachusetts Institute of Technology, Boston, Massachusetts.

(2.) The Manual Training School of Washington University, St. Louis, Missouri.

(3) The Mechanical Handiwork Schools of the Spring Garden Institute, Philadelphia, Pennsylvania.

(4) The Chicago Manual Training School, Chicago, Illinois.

(5) The Manual Training School of the Tulane University of Louisiana.†

It will be observed that, in the curriculum of each of these typical schools, while drawing is regarded as a most essential study and is pursued throughout the entire course, and while the manipulation of tools is persistently taught, the general education of the pupils is, also, carefully provided for; the courses in these particulars varying somewhat in the several schools but, in each one, good schooling in the common English branches and in mathematics, forms an essential part of the training given ;—the black board and the class room being held to be quite as important, if not quite as novel, as are the drawing board and the machine shops.

After these elementary schools would naturally follow the class of special technical trade schools, at present only represented in this country by those grouped under a single institution,—namely The Metropolitan Museum of Art and known as:

(1) The Technical Schools of the Metropolitan Museum of Art.

(2) The Technical Schools for Carriage-draftsmen and Mechanics, New York, N. Y.

These special schools are, by reason of their limitations to single trades, of less general interest than are the larger institutions devoted to general training in the mechanic arts. These latter may be classed as Technical Mechanical Schools, and comprise the following separate schools or departments of other institutes.

(1) The Worcester County Free Institute of Industrial Science, Worcester, Massachusetts.

(2) School of Mechanical Engineering, Illinois Industrial University.

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*See Special Report on "Industrial Education in the United States," 1883; the Circular No. 5, 1888, on "Industrial Education in the South," by Rev. A. D. Mayo; and the Annual Reports of The Commissioner of Education.

†The Tulane University was founded since the above list was first reported. A brief account of the University is given with that of this school which follows. See page 79, *et seq.*

(3) Rose Polytechnic Institute, Terre Haute, Indiana.

(4) Mechanical Courses in Cornell University. Sibley College of Mechanic Arts, Cornell University.

(5) College of Mechanics—University of California, Berkeley, California.

The Colleges of Agriculture and The Mechanic Arts, endowed by the National Land Grant, 1862.

The Schools of Science and Engineering, such as the Stevens Institute, Hoboken, etc.

It does not fall within the province of the present Report to enlarge upon the variety of culture afforded in their many departments by these superior schools of science, among which are found both those privately endowed and several of those endowed by the National Land Grant.

The schools of science connected with Yale, Harvard, Columbia, Dartmouth, Lehigh University, and also the Stevens Institute, Hoboken, the Massachusetts Institute of Technology, the Rensselaer Polytechnic Institute, Troy, and others, entitled to mention if this were an exhaustive list; fill, perhaps, their highest usefulness in the opportunities they afford for the training of original investigators in science and the arts, who shall point out the way to the future development of the natural resources of the country.

It is, however, only as the study of drawing enters into their several courses, and as they give instruction in practical mechanics, the construction of machinery, or in architecture, that they are here included; but it is well known that among the foregoing are institutions giving instruction, practical and theoretical, in the mechanic and engineering arts, both in their elementary principles and their broadest scope.

The Arts of Design, applicable to textile manufactures, and the application of art to industries, are taught, so far as they are taught, in another class of institutions. In the United States, "The Lowell School of Applied Design," attached to the Massachusetts Institute of Technology, is (in 1883) believed to be the only school solely devoted to teaching practical designing;—especially in its classes of design for textile manufactures;—that is, to the training of working designers who shall be competent to step at once, from the class rooms to the factory.

The training in the Massachusetts Normal Art School, looks to designing, and some of the women's art schools give more or less attention to design, and are directing more and more attention to practical training for this purpose; but still it remains that, as yet, the "Lowell School," is the one technical school for practical designers.

The instruction in the classes of "The Pennsylvania Museum and School of Industrial Art," which institution would naturally be

looked to as leading in all matters relating to instruction in the application of art to the industries, has varied in its purpose at different periods since its first establishment. A portion of the technical training formerly under its direction has been transferred to the "Philadelphia School of Art Needlework." The instruction at present given (in 1883–'84) is thorough, and based upon a correct conception of how best industrial art and artistic industries, are to be developed. The groundwork of a thorough mastery of drawing as preliminary to any special applications of that mastery to the industries, is now insisted on, with the best results. To apply successfully art to industry one must have some knowledge of art.

It goes without saying, however, that the institution will hardly fulfill the hope felt at its founding, namely, that it would provide for the United States, advantages similar and equal to those which the South Kensington Art Schools offer to English students, if it does not eventually add to its facilities technical training schools in the various occupations of art industry.

At present this school might be properly classified with the fine art schools; as might also the several women's "Schools of Design," and the classes under direction of the Women's Decorative Art Associations, etc., in the several cities; in which, it seems rather a matter of accident whether the industrial features, or the artistic features, predominate.

The question of classing these institutions, and, also, the "Schools of Architecture," with those of Art Industry, or with those of the Fine Arts, in the volumes of these Reports given to those separate topics, will be settled rather by convenience of binding than by any attempt to strictly define them; since they are sufficiently germane to both, to be included in either classification.

Since the above was written, the number of the Revue des Deux Mondes for November 15th, 1884, has been received; this contains an interesting article entitled "Les Industries D'Art,"—a review, by Mr. C. Lavollée, of the recently issued official Report "On the condition of the Art Industries of France and of the workers employed in them," made by M. Antonin Proust, Deputy and former Minister of Arts.

The following lines from the opening sentences of this paper, refer to the difficulties of classification, to which I allude, as inherent in the subject itself.

"Every work produced by the labor of man, implies the intervention of Art. * * *. In short, Art and Industry are inseparable companions. More and more, these two elements become blended so that the question of art takes, each day, a more important place in the consideration of those economic problems which are connected with the questions of labor. Henceforth the development of Industry is intimately blended with that of the Fine Arts and in the midst of universal competition, artistic superiority procures for that country which possesses it as much profit as honor."

The importance placed upon the Art Industries of that country is manifest by the interest taken in them by the Rulers of France; shown, incidentally, by this official Report concerning them.

It would seem that the people of the United States, and the authorities of the several States, would need nothing other than the example of the people and Governments both of Great Britain, and of France, to arouse them to the imperative need of similar action on the part of their own communities.

The statement in the pages immediately preceding, written in 1883, that the Lowell School of Design connected with the Massachusetts Institute of Technology, was the only school in the United States in which designers for textile fabrics could be trained so that they were qualified to pass directly from the school to the designing room of the manufactory; is, in 1893, fortunately, no longer true.

In 1885, the Textile Association of Philadelphia, became satisfied that the school of "The Pennsylvania Museum and School of Industrial Art,"—which had been for some years under the wise and skilful art instruction of Mr. L. W. Miller, as already stated,—afforded the best instrumentality for their purpose of training technical designers, and a collection of the best and latest machinery for textile manufacture, was furnished for the use of the school. This has recently been followed by the opening of a dyeing department, so that the pupils, who are first taught artistic drawing to enable them to make the pattern, then, themselves, dye the yarn from which it is to be woven, and weave it in the loom, getting thereby practical experience in every manipulation of the craft. In 1888–'89 the plan of establishing similar training facilities for Potters and artists in Porcelain decoration, was seriously considered by the United States Potters Association, and in 1890 such an additional department was opened. The State of Pennsylvania has at last recognized the usefulness of this school by an annual appropriation, and there is good reason to believe that the sanguine anticipations of the enthusiastic founders of the school may come, in time, to a satisfactory realization.

In Philadelphia, in addition to these facilities, the Woman's School of Design, at present under the able direction of Miss Emily Sartain, possesses looms in which the patterns of the students are woven. This interesting school in which the practical application of Art to Industry is effectively taught, and which surely posseses a strong claim to State aid, for the same reasons that such aid is given to the school just mentioned, namely, that this school, also, is training a large class of practical industrial art workers, has gradually developed into what might, with propriety, be called a group of Art Trade Schools. The Art School of the Spring Garden Institute, also, has a pottery kiln in which the porcelain decorated by pupils can be fired; so, little by little, as seen in these three Philadelphia

Schools, the practical development of Industrial Art training progresses towards the direct application of art to industries.

It is only by increasing facilities for such definite experimental training, that the desired results in the artistic improvement of the nation's productive industries are to be effected.

So much space in the volumes of this Report already issued has been occupied by the accounts of the recent elementary industrial education movements throughout the country, that the detailed history and description of this Philadelphia "School of Industrial Art," and of the several Women's Schools of Design in this country, will be grouped in the succeeding volume, Part V of this Report, in connection with the several schools and academies of the Fine Arts; with which they are, in fact, more closely allied than with the Mechanical Schools of Manual Training, or the institutions for Technical Industrial Education, described in the present volume.

CHAPTER II.

PRIMARY GROUP: MANUAL TRAINING SCHOOLS.

The relation held by the two pioneer Manual Training Schools to the public schools of the country—These schools experimental—The schools described by President Runkle in 1880—Industrial Drawing at the foundation of the courses in Manual Training—The present chapter, the early portion of which was written in 1883, an object lesson in illustration of the rapid spread of the movement for Public Manual Training Schools in the United States—List of publications concerning Industrial Education and Manual Training by Ex-President Runkle, President Walker and Professor Ordway, of the Massachusetts Institute of Technology. Page 10.

An account of The School of Mechanic Arts, of the Institute of Technology, as revised for this Report by Dr. Runkle—The New Temporary Building—The plant of tools and machinery for wood and iron working—Report by Mr. Thomas Foley, the Instructor, on the methods of instruction in the school—with detailed courses in metal working—Letter from President Runkle to the author of this Report—Statement of the school in the catalogue of the Institute for 1882–'83—Statements in succeeding catalogues down to that of 1890–'91. Plea by President Walker, in 1890, for an increased share of the National Land Grant Fund, based on the remarkable development of the schools and departments of the Institute during the twenty-seven years since it was opened. Page 13.

The Manual Training School of Washington University, St. Louis, Missouri—The story of its origin and growth down to 1883, told by Professor Woodward for this Report—The ordinance establishing the school June 6th, 1879—The course of Instruction—The courses of study in detail—The purpose of the school—The building and plant—The success of the school—Statement by the St. Louis Republican—The school indorsed in his message by Governor Crittenden—General Armstrong, of Hampton, Virginia, commends the school—Letter by Professor Woodward, Director of the school, to a public journal, "The Reporter"—A list of the several Departments of Washington University—Director Woodward on the relation of the Manual Training School to the Polytechnic School of the University—The Manual Training School as described by Dr. Woodward in a paper read before the American Society of Mechanical Engineers during the meeting in Chicago—Report of the discussion of the paper by several of the members—Results of experience as stated by the Director, in December, 1886—Summaries of condition of school in its twelfth year, from the catalogue of 1891–'92—List of Officials and Instructors for 1891–92. Page 28.

The Mechanical Handiwork Schools of the Spring Garden Institute, Philadelphia—This Day School an outcome of the night classes described in chapter II of this volume—Special instruction given in steam engineering—The beginning of the day school described, 1882—Interesting showing of occupations in which the pupils of the different classes were employed—Courses of study as given in 1882–'83—Girard College authorities decide to adopt a similar course of instruction—Reports of attendance and progress from 1882 to 1888. Page 60.

The Chicago Manual Training School, Chicago, Illinois—The school founded and endowed by the Commercial Club in 1882—Charter obtained in 1883—Address by

Mr. E. W. Blatchford, President of the Commercial Club, on the laying of the corner stone, Septemper 24th, 1883—School opened in 1884—The preliminary announcement of courses of study—Exhibition of pupils' work, 1886—Equipment of Mechanical Department as given in 1886—Increased attendance and enlarged equipment of school in 1891—Number of pupils for 1890–'91, 303—Report on annual exhibition of pupils' drawings, made in 1889—Summary of work of pupils shown at exhibition of 1890—List of Trustees and Instructors, for the year 1890–'91. Page 69.

The Two Pioneer Schools.

The two typical manual training schools of the country, in which the experiment of combining an elementary English education with definite training in the Mechanic Arts has been intelligently and earnestly undertaken, are the School of Mechanic Arts of the Massachusetts Institute of Technology in Boston, Massachusetts, and the Manual Training School of Washington University, St. Louis, Missouri.

Descriptions of these two schools were included in the paper on "The Manual Element in Education," by John D. Runkle, LL. D., formerly President of the Massachusetts Institute of Technology, which accompanied the 45th Annual Report of the Mass. Board of Education. (1880–81.) Descriptions of these schools also appear in the Special Report on Industrial Education, made by the U. S. Bureau of Education and published a few weeks since. (1883.)

They find place in this present volume as being a contribution towards the solution of the problem of how the public schools are to best accomplish their work of furnishing to the people of America the most useful education. These two schools fill a place before vacant. They stand to the scholars in the elementary schools, who desire practical training in the Mechanic Arts, as do the High Schools to those who desire further training in the "literary arts," if I may so term them. As the High School and Academies are the vestibules to the Colleges and Professional Schools, so these two schools are the steps leading up to the technical schools such as the Worcester County Institute and the Agricultural Colleges and Schools of Science.

In these two experimental schools, one in the East and one in the West, private Institutions and individual enterprise and liberality are testing the methods which, if continuing as successful as at present, may naturally become the model of a class of schools which, sooner or later, the towns and municipalities will be forced to adopt.

In these two schools it will be observed that a knowledge of industrial drawing,—the adoption of which in all public schools has been so persistently urged in this work,—is an absolute requisite.

It is this direct application of the study which has secured for those institutions entrance into this "Report on Drawing and the Arts, as they affect the industries and prosperity of the people."

I am indebted to Professor Runkle and to Professor Woodward, for their kindness in preparing, at my request, especially for this Report, the descriptions of their respective institutions, as they are in the autumn of this year 1883. Professor Runkle having furnished the needed addenda to his former paper and Professor Woodward having rewritten the account of his school, so that they are both brought down to the latest moment.

Accounts of several similar European schools will be found in the Appendix among the foreign industrial training Schools.

The previous passages of this chapter were written in regard to these two schools,—then the only schools of their kind in the United States, in the autumn of 1883, when this volume was made ready for printing in 1884. By reason of the delay in publication so often referred to, this Report has become, in its present form, a veritable "object lesson" illustrating the rapid progress of the Industrial Education movement which received its strongest early impulse in the founding of these two typical schools of Manual Training; and was promoted by the many public addresses delivered to educators, and by the various papers and other publications, put forth by President Runkle, Professor Woodward, Professor Ordway, and the group of enthusiastic advocates of the new methods, who had gathered about these pioneers.

The fact that so large a part of the previous volume has been given to an account of the Industrial Education movements, both in the public schools and by the Industrial Education Associations, notably the one in New York City of which Dr. Butler is president, —is, in itself, conclusive evidence of the extent and vigor of the movement thus set on foot. What was then here said in regard to these schools is suffered to remain, partly because it is wholly impracticable to re-write all of this Report if it is ever to appear; and, partly, because the histories given in the preceding volume have confirmed the opinion then expressed, namely, that these schools would become the models of a new class of public schools.

A concise statement of the Massachusetts Institute of Technology and all its different departments, with illustrations of the shops and shop work, was given in the special Report on Industrial Education published by the U. S. Bureau of Education in 1883. (See pages 142–157 of that Report.) Much space was given to an account of the Manual Training School and the new methods of industrial training. Some of the illustrations follow here.

A recent publication by the Alumni Association of the Institute,* giving lists of all the publications, other than in the daily journals,

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*Publications of the Mass. Institute of Technology and of its officers, students, and Alumni. 1862–1887. Compiled by William Ripley Nichols. Second edition, revised by Lewis M. Norton. Published by the Alumni Association, Boston: W. J. Schofield, Printer, 105 Summer Street. 1888. Pp. 96."

which have been made by the officers, students and graduates of the Massachusetts Institute of Technology, furnishes striking evidence of the varied intellectual activity which is developed, trained and stimulated, by this admirable Technical University; and is well worthy the careful study of any who are doubtful as to the direct value and influence of such institutions upon the intellectual as well as the Industrial life of a country. The following lists of the publications, by Dr. Runkle, the former president; General Walker, the president; and by Professor Ordway, directly relating to these new methods of Industrial Education, partly embodied in the Manual Training School here described, will serve to show how knowledge of the new methods was disseminated among the educators of the country. In all, Dr. Runkle, is credited by titles with nine publications, of which five relate to Industrial Training; President Walker, with twenty-six works on various subjects, of which three are on this topic. Professor Ordway, with fifteen publications, of which three relate directly to Industrial Education. The full titles of these Industrial Education publications follow:

John D. Runkle, Ph. D., LL. D. Prof. 1865—; Acting Prest. 1868–70; Prest. 1870–78.

1876. The Russian System of Shop-work Instruction for Engineers and Machinists. [Addressed to the Corporation by J. D. Runkle, Prest.] Pph 8vo, pp. 24. 1st. ed. July, 1876. 2d ed., with supplementary statement, August, 1876. n. t. pp. 24.

1876. The Manual Element in Education. Rept. Mass. Board of Education, xli (1876–77). Also printed separately. Pph. 8vo, pp. 36 and 8 plates.

1881. Technical and Industrial Education Abroad. Proc. Soc. Arts, M. I. T., 1880–81, 83–90.

1882. The Manual Element in Education. From the Forty-fifth Annual Report of the Massachusetts State Board of Education. Pph. 8vo, pp. 72. Boston.

1884. Report on Industrial Education. Pph. 16mo, pp. 34. Boston.

Francis A. Walker, Ph. D., LL. D. President 1882—.

1884. Industrial Education, read before the American Social Science Association, Sept 9, 1884. Pph. 8vo, pp. 16. [Society's Journal, 1884. Part 1, pp. 117–131.]

1886. What Industry, if any, can Profitably be Introduced into Country Schools? Science, ix, 365.

1887. A Plea for Industrial Education in the Public Schools. Pph. 12mo, pp 34. Boston.

John M. Ordway, A. M., Prof. 1869–1884.

1882. Slöjd Schools. Mass Teachers' Asso. 1881–82. Addresses, 1882.

1882. Handwork Instruction in Sweden. 46th Ann. Rept. Mass. State Board of Education, 1881–82, 161–213.

1883. Education as Illustrated in the Nüremberg Industrial Exhibition. Proc. Soc. Arts, M. I. T., 1882–83, 89–93."

The following account of the School founded by the Institute of Technology, is taken from the article contributed to the Forty-Fifth Annual Report of the Massachusetts Board of Education, by Ex President John D. Runkle, with additions made by him for this Report to bring the account to date, as already stated.

SCHOOL OF MECHANIC ARTS.

INSTITUTE OF TECHNOLOGY, BOSTON, MASS.

This school was founded by vote of the corporation of the Institute, dated Aug. 17, 1876. Since Oct. 1, 1878, it has been in charge of a committee of the faculty, Professor John M. Ordway, chairman, upon whom has devolved the main direction of the school. While adhering to the spirit and method of instruction, the aim has been to make the work in all departments as practical as possible, by selecting useful forms, if equally good, to teach the particular manipulation. The accompanying pages of cuts, showing series of samples used in each shop, are given as a general illustration, and not as the only, or even necessarily the best, series, for teaching the manipulations in each case. Every qualified teacher will naturally design his own course, and will also modify it from time to time as experience suggests. There is obviously the same freedom here as in the teaching of other subjects. The mechanic art courses are as follows: In *wood*—I. Carpentry and joinery; II. Wood-turning; III. Pattern-making. In *iron*—I. Vise-work; II. Forging; III. Foundery-work; IV. Machine-tool work.

While these shops are used for the practical instruction of our students in mechanical engineering, and for such other professional students of the Institute as desire it, they are most largely used by students in the school of mechanic arts. This school, in which special prominence is given to *manual* education, has been established for those who wish to enter upon industrial pursuits, rather than to become scientific engineers. It is designed to afford such students as have completed the ordinary grammar-school course an opportunity to continue the elementary scientific and literary studies, together with mechanical and freehand drawing, while receiving theoretical and practical instruction in these various arts, including the nature and economic value of the materials with which they deal. Nine hours per week—three lessons of three hours each—of the students' time are devoted to shop-work, and the balance to drawing and other studies; only one shop course, except in the case of special shop students, being carried on at a time.

It may be well, now, briefly to indicate the steps necessary to be taken in fitting up a shop and in working out the course of study.

The Shop.—1. Settle upon the tools and appliances to be used during the course. 2. Decide how many students can be taught in a section. 3. Design the fitting up of the shop, giving each student the proper space and facilities, and so arrange that each student, in each section, can lock up and control his own tools and instruments, which are not to be used in common.

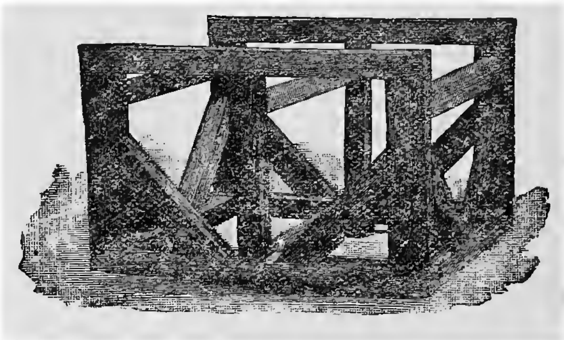
The Course of Study.—1. Design a series of progressive lessons, especially adapted to teach the use of the set of tools and appliances pertaining to each course. 2. Let the master work each lesson, or sample, that he may settle clearly in his own mind, the best method of solution, with a statement of the reasons therefor. 3. A system of inspection upon which the quality of the work can be based, and each student given his proper percentage, and which shall also be the means of educating the judgment of the student, that it may keep pace with his skill of hand to execute.

We find, then, that in this practical part of the problem there are three distinct educational steps. First, the best method of solution. Second, skill of hand to execute the work. Third, the capacity to judge of the quality of the work.

The theoretical studies are arithmetic, algebra, geometry, English, physics, and drawing. The shops are arranged for teaching sixteen in a section, except that for forging, which contains only eight forges, on account of the smallness of the room. The deficiency has been remedied as far as possible by enlarging the foundery, and using portable forges.

All our shops are entirely too small for the work we are endeavoring to do in them, and the present temporary building must soon be replaced by a larger and better adapted one, if the purposes of the school are ever fully realized.

The Carpentry, Joinery, Wood-Turning and Pattern Shop.—This shop is 50′ by 20′, one end containing the carpentry and joinery benches, and the other the wood-turning lathes shown in the cut. The lathes are placed four on each side of two benches, and under each lathe are four drawers to hold the tools of the four sections. The carpentry and joinery benches at the other end of the room are similarly arranged. In the middle of the room, the cut shows the saws for cutting up the lumber to the dimensions needed in the courses of instruction. The first instruction in carpentry and joinery is the use of the saw and plane in working wood to given dimensions, and then a series of elements follow in order. (See cut.) No. 1, a square joint; 2, a mitre joint; 3, a dovetail joint; 4, a blind dovetail; 5, a mitre dovetail; 6, a common tenon; 7, a key tenon; 8, a tusk tenon; 9, a brace tenon; 10, a pair of rafters with collar beam; 11, a truss tenon; 12, a drawer; 13, a panel. In addition to the above each student makes a small frame, to apply several of the elements of the previous lessons. A sample is given in the cut.



SMALL FRAME.

The instruction in turning (see cut) and circular-section pattern-making is given in the following series of models. Nos. 1, 2, and 3 represent a series of manipulations in simple turning; 4, 5, and 12, pulleys; 9, a globe-valve; 6, 7, 8, 10, 11, 13, 14, patterns for various forms of pipe. Corresponding core patterns form part of the course. Bench patterns, and bench and lathe combined, are not included for want of space.

The instruction in this shop is given by Mr. George Smith, assisted by Mr. Z. Nason.

The Foundery.—The cut representing the foundery shows a part of the sixteen moulding benches, combined with troughs for holding the sand, with the cupola furnace at the other end of the room. Over the furnace is seen the Sturtevant fan, which exhausts the heat and dust from the blacksmith's shop beyond. The furnace connects with a flue which passes out of the shop, thence underground, into a chimney in the rear end of the main Institute building. The blast for the furnace is taken from the pipe shown over the door, in the rear right-hand corner of the room. An average charge of the furnace is about five hundred pounds.

Foundery Course.—Nos. 1, 2, 3, 4, 5, are pieces used in the course of filing and chipping; 6 and 7, curved castings; 8, a sheave; 9, a pulley; 10, a pulley; 11, an eccentric; 12, a clutch; 13, 14, 15, 16, 17, 18, 21, parts of a loom; 19, 20, cogwheels; 22, a rack; 23, a shield.

The Forging Shop.—This shop is fitted with eight forges. The Sturtevant pressure blower, which furnishes the blast for the forges, is placed in the engine-room. The hoods over the forges are connected with a sixteen-inch pipe, which runs longitudinally near the ceiling of the shop, and enters a No. 4 Sturtevant exhaust

blower in the foundery. This exhaust blower removes all smoke and dust, and much of the heat. This shop was planned and fitted by Mr. B. F. Sturtevant of Boston at his own expense. The school is also indebted to him for other valuable assistance.

The Machine-Tool Shop.—This shop contains sixteen engine lathes of 4¼′ bed, four speed lathes, and a Brainard milling machine. The engine lathes were made for the school by the Putnam Machine Company of Fitchburg, Mass., from new designs, and furnished at a greatly reduced cost, and have proved in all respects first-class tools. Under each lathe is a chest of drawers to hold the tools belonging to the students using it. A bench under the window holds the requisite number of vises. The shop needs a variety of additional tools, which are not furnished for want of room.

The Chipping, Filing, and Fitting Shop.—This shop contains benches with sixteen vises and other needful appliances, with planer, grindstone, etc., for which there is no room in the machine-tool shop.

The instruction in forging, vise-work, and machine-tool work is in charge of Mr. Thomas Foley, a thorough and skillful mechanic, who has served his seven years' apprenticeship, and has had, besides, a long and varied experience in his profession. He has a clear comprehension of the problem of mechanic art education; and has, during the past five years, shown equal capacity as a teacher. He recognizes that the student should acquire something besides simple manual training in this department of education. A want of method, a want of appreciation of the ends to be gained on the part of the teacher, are both fatal to the best results. Mr. A. W. Sanborn, a graduate of the school, is Mr. Foley's assistant.

It gives me great pleasure to submit Mr. Foley's report, as follows:—

Professor J. D. RUNKLE.

DEAR SIR,—The system of apprenticeship of the present day, as a general rule, amounts to very little for the apprentice, considering the length of time he must devote to the learning of his trade. He is kept upon such work as will most profit his employer, who thus protects himself. If the apprentice should be thoroughly taught all branches in the shortest time, he would be likely to leave as soon as he could do better, letting his employer suffer the loss of time devoted to his instruction.

Now, it appears like throwing away two or three years of one's life to attain a knowledge of any business that can be acquired in the short space of twelve or thirteen days by a proper course of instruction. The dexterity that comes from practice can be reached as quickly after the twelve days' instruction as after the two or more years spent as an apprentice under the adverse circumstances spoken of above. The plan here is to give the student the fundamental principles in such lessons as will teach them most clearly, and give practice enough in the shortest time to acquire a knowledge of the different kinds of tools and various ways of using them. For instance, if a man can make a small article in iron, steel, or any other material, perfectly (by such methods), he can make it of larger proportions with the additional time and help required for such an undertaking. The same in degrees of heat required for fusing or welding metals: if he can do it well in a lesser degree, he can certainly do so in a greater with the additional facilities.

After nearly five years' experience in the workshops in my charge, with the valuable suggestions of the professors so much interested in the success of the school, we find the best results in the time allowed, accomplished by the method now in use in the Institute workshops; viz., three lessons per week of three hours each.

The time is just sufficient to create a vigorous interest without tiring: it also leaves a more lasting impression than by taxing the physical powers for a longer period. We have tried four hours a day, and find that a larger amount of work, and of better quality, can be produced in the three-hour lessons.

In order to give each student the proper credit, and to show him the most important points in each piece, the following method has been adopted for inspection: Take case of bending. The four shapes to the right of 4 on the cut of forgings represent bending of flat and round iron; and the points to be noted by the student are rated as follows:—

Dimensions	25
Form	70
Finish	5
	100

The most important point in this lesson is the form; the next the dimensions, and the last the finish. Through all the iron-working and other metal in each shop, the same method is carried out. Every piece is made to certain dimensions laid down upon the drawing. The object of working to dimensions is to establish the necessity of correctness in measurement, and is followed throughout the course as a very essential point. The most of the exercises convey the idea of the necessity of straight lines in drawing or lengthening iron, and graceful curves in bending.

"The iron-forger's art is composed of the following terms and movements:—

First. The management of the fire, and the degrees of heat necessary for each particular metal forgeable.

Second. Drawing down, or reducing the cross-section.

Third. Bending without materially changing the cross-section.

Fourth. Upsetting or shortening the piece, and increasing its cross-section.

Fifth. Fagoting, or building up for welding, and welding the same; and welding without fagoting or building up, understood generally as welding.

Sixth. Splitting.
Seventh. Punching. } The terms are so well understood that they need no explanation.

Eighth. Chamfering, means hammering the edges down to give the piece a light appearance.

Ninth. Annealing steel.

Tenth. Hardening and tempering steel.

Eleventh. Case-hardening iron.

Annealing brass, copper, etc., is often done by the forger, but does not really come under this head, although it is taught in this department.

The varied forms of construction are simply the adaptation of the instruction course to such variation.

Together with the main tools—the planer, lathe milling-machine, upright drill, etc.—used in the machine course, the uses of each auxiliary tool are thoroughly explained, and sufficient practice given in short lessons to place the student on a par, so far as the general knowledge goes, with the three-years' apprentice.

The methods adopted here are as follows: A sketch of the piece is laid out to the working dimensions on the blackboard for reference during the exercise. The article is then forged in detail by the instructor before the class, calling their attention to each particular point necessary to its successful formation at the same time. There are also duplicate pieces distributed through the shop to refresh the memory and assist the eye in forming. Each student is rated according to the quantity and quality of his work, which is judged by the rules laid down for inspection.

A BRIEF EXPLANATION OF THE COURSE IN IRON AND STEEL FORGING, HARDENING AND TEMPERING STEEL, AND CASE-HARDENING IRON.

The first lesson comprises the building and keeping forge fires in proper condition, upon which depends in a *great* measure the success of forging. It also takes in the degrees of heat necessary for the successful working of the metals in their varied

forms. The other lessons will be explained briefly but technically in order corresponding with the number in the cut to be found to the left of each piece, or in the centre of the piece when it can be so placed to advantage.

No. 2. *Cutting Cold Iron, Bevel-Forging, Drawing, Forming, and Bendin.*—The bevel-forging is shown in the first form of the piece, but destroyed in taking its final form.

No. 3. *Drawing and Forming.*—Drawing is reducing the cross-section. Forming will be better understood by the following description of the entire piece: Drawing from a round piece to form a square, then to form a portion of it octagonal, and lastly to a tapered round point. In this figure welding is introduced to show the necessity of so doing when using common iron (iron most generally used). The result of drawing such material without using a welding heat would be the separation of its parts lengthwise. In this piece the necessity of maintaining straight lines is impressed, and expected to be carried out in future lessons.

No. 4. *Bending* does not change the cross-section as much as drawing. In some cases it is hardly perceptible. This exercise consists of bending round and flat iron in a circular form. The two staples in the centre of the rings take in drawing with the bending, and are made in a useful form only because it can be done as well so without taking up extra time that might be put to a more profitable use.

Let me say here, that all through the course, whenever the principles can be introduced in a useful form without occupying more time than would be spent in a plain form, it is invariably carried out.

No. 5. *Welding, Fagot-Welding.*—This lesson is intended to show how iron can be increased in size by joining a number of pieces together by welding where it could not be done so easily or profitably by upsetting.

No. 6. *Upsetting, and Bolt-Making by Upsetting.*—Upsetting shortens the piece, and increases its cross-section. The first piece to the right of the figure 6 shows a piece of round iron upset at one end enough to make a square from the round of the same dimensions as the diameter of the round, and intended as preparatory to the working of the other figure to the right,—a bolt upset in the same manner to form the square head, enough being upset at the end of the piece to form the head in a heading-tool.

No. 7. *Upsetting while Bending and Forming.*—This piece, being a square made of square iron with well-defined corners inside and out, is pretty difficult to make by this method if great care is not taken in handling it. This method saves considerable time where it can be used. It is not the strongest form, and only used where neatness in appearance or nice fitting is required.

No. 8. *Upsetting before Bending and Forming.*—This piece being square only on the outside, while the inside corner is round, it is a stronger form, but for purposes differing from fig. 7; viz., a knee, angle-iron, or bracket, as it is termed. Sometimes it is intended to show different methods of doing work similar in construction.

No. 9. *Bending and Twisting.*—Bending in this case (the piece being a floor-timber hanger) is done without upsetting, leaving it strong enough for its purpose by making the inside and outside of the turn rounding. The twisting is simply to bring the other end in position to receive the timber.

No. 10. *Drawing, Bending, and Twisting.*—The object in drawing the ends is to alter the form from square to round, and also make it lighter where the hook and eye are turned, the bending of which has already been described. The twist in the centre of the square part is intended to show how this part of ornamental work is done. The other figure No. 10, an S hook, as it is termed, is a part of this lesson, and is intended to accustom the student to the graceful curving of iron.

No. 11. *Upsetting, Welding, Forming, and Punching.*—A tool for making the heads of bolts, rivets, etc., known as a heading-tool.

No. 12. *Upsetting, Drawing, Bending, Chamfering, and Punching.*—This piece,

a bracket, combines the movements designated by the heading of the lesson. We find, in such combinations throughout the course, that it keeps the student well up in memory (and practice with the hands) of the past lessons.

No. 13. *Bending, Drawing, Welding, and Forming.*—In this combination the ring is made in three pieces, involving the above movements. The object of this piece is to show how large bands of this form can be made with economy of time and material.

No. 14. *Butt or Jump Weld.*—This piece is intended to show how a swell can be made in the centre, or any other point, of the bar; also to show the treatment such welds should receive after welding, in order to preserve the strength of the weld.

No. 15. *Drawing and Upsetting in Heading-Tool.*—Rivets and clout or dog nails are what has been made in the tool No. 11. The main feature in the lesson is making the required shaped head, and keeping the body of the piece in the centre of the head.

No. 16. *Upsetting and Drawing.*—One of the hexagonal-headed bolts was made by upsetting the bolt to form the head. The other, a small one, No. 16, will be found forming a part of No. 13, and was made by drawing the body of the piece, and forming the head out of the stock from which the body was drawn. The object of this lesson is to give the necessary practice required to form the sides of the head uniform.

No. 17. *Punching. Making Square and Hexagonal Nuts.*—In this lesson the different methods of making nuts by the use of the hammer alone, and by the use of the hexagonal tool, are carried out.

No. 18. *Upsetting, Punching, Welding, and Fitting.*—This piece, a solid eye-stay or brace, as it is termed, besides the combination used in former lessons, takes in fitting or setting the piece to a given angle as a support. Countersinking for screw-heads is also included.

No. 19. *Punching, Splitting, Forming, and Welding.*—This form of hasp is only introduced to give practice in splitting, along with the other processes.

No. 20. *Bending, Scarfing, and Welding Round Iron.*—The links of chain that form the lesson introduce a different scarf for welding from the ordinary one of straight round iron. The twisting of the chain is also brought in here.

No. 21. *Bending and Welding Flat and Edgewise.*—The two pieces numbered as above are close together on the plate, and need but little explanation on account of the correctness of their delineation, the difference in the shape of scarfing before welding being the only excuse for making this remark as the point of the lesson.

No. 22. *Drawing, Bending, and Welding.* A piece well known as an eye-bolt or ring-bolt, the manner of shaping and scarfing being the particular points in the piece. A nut at the end of the bolt, with a screw cut upon it, will be described at the close of the lessons. This figure will be found upon the cut in conjunction with No. 28, a ring welded after being passed through the eye, making the piece complete.

No. 23. *Drawing, Welding, and Forming.*—The main point in this piece is the formation of the eye by turning and welding it in such a manner as to make it appear as a solid piece of metal punched and worked out. It is only intended, as a general thing, for work to be finished. The figure itself is intended for a rope-hook.

No. 24. *Drawing, Punching, Upsetting, Welding, and Riveting.*—In introducing this piece it is considered necessary that the student should be able to construct one of the most essential tools used in the art of forging, viz., a blacksmith's tongs; and, as it combines nearly all that has been gone through in former lessons, it naturally brings to mind what might be lost in a measure without such a combination of them.

No. 25. *Punching, Drawing, and Forming.*—The piece here represented differs

only in the formation of the eye (by punching) and the hook part (by flattening, to give it greater strength) from No. 23. This hook is used generally as a chain-hook.

No. 26. *Scarf-Welding, Flat Iron. (Common Iron.)*—This piece, an L or right-angled weld, has to be scarfed in a different manner from anything before in this course, and on this account it is brought in here, with the additional point, squaring the piece.

No. 27. *Scarf-Welding, Flat Iron. (Norway Iron.)*—A different form of scarf from last number. It is what is termed a T-weld, and the peculiarity of the scarf is one of the most essential points; another, the forming of the piece before taking a second welding-heat, in order to give the piece the appearance of being solid. In this lesson we use the best of iron, and in the last poor iron, or what is in common use: by this means the student is brought to see the difference of treatment in welding the two qualities of iron.

No. 28. *Bending and Welding.*—The figure with the number above attached in the cut is a ring welded after being passed through the eye of the ring-bolt No. 22, making the two as one complete piece, a ring-bolt. The most particular feature in this piece is the forming of the scarf in such a manner as to make the welding of it easy.

No. 29. *Jump Weld, Round upon Flat.*—The round and flat iron welded in this way clearly shows by their scarfing how any other shaped iron can be welded together in the same way. In this piece the scarfs differ from the former scarfs materially. The varied uses to which the piece may be put may easily be perceived

No. 30. *Drawing, Forming, Punching, and Welding.*—This combination brings into play some difficult movements in order to produce a sound swivel, as the piece is termed. One of the pieces forged in lesson No. 15 forms the revolving portion of the piece when completed.

No. 31. *Bending and Riveting.*—The tripod with this number in the centre, although it takes in bending, is intended more particularly to show how riveting cold iron is done. By the addition of bending, it leaves the piece in a useful form.

No. 32. *Scarfing, Riveting, and Calking Boiler-Plate.*—The object of this lesson is to show how iron plates can be put together, and made steam-tight. Some of the rivets are riveted with the use of a heading-tool, and some are riveted in the ordinary way with hammers. The piece is afterwards calked to make it tight, with a tool termed a calking-tool.

No. 33. *Steel-Forging.*—Cast steel of different grades and different manufactures is introduced throughout the course of steel-forging. Spring steel, too, is taken in, and the many ways of determining the quality and method of treating it in its various changes.

The first piece, No. 33, is an S wrench,—to be finished in the filing course, where the reasons for so doing are explained. In forging this piece the degree of heat necessary for the successful working of steel is practically illustrated by the instructor, and consequently very few failures occur. Annealing, or softening, hardening, and tempering, comes in at the close of the steel lessons.

No. 34. *Welding Steel and Iron together, and Steel and Steel together.*—A flat piece of iron and steel are welded together, after the very essential preparation in scarfing, and then the steel and steel are welded, making the piece complete in six inches in length.

No. 35. *Forked or Split Weld. (Steel and Iron.)*—A form of welding in more general use than any other; and, wherever it can be used with convenience, insures economy in time and strength in the piece, being supported on each side by the iron, making, as a general thing, a better weld or more substantial piece.

No. 36. *Tapers and Bevels. (Cast Steel.)*—A blacksmith's punch and cold-chisel, numbered as above, upon the cut, is intended to carry out the heading of the lesson, making true tapers and bevels throughout.

No. 37. *Drawing and Forming.*—The first one, a right-hand, diamond-pointed lathe-tool (to be used in the machine shop). The correctness of its shape and temper prompts the student to have it as near perfect as possible, on account of having to use the same tool in his future work.

The second, a ratchet drill (its shape and temper differing considerably from a lathe or vertical drill) is clearly explained, while in comparison the other forms are shown at the same time.

No. 38. *Drawing Tapers and Bevels.*—The first piece of this number, a graver or diamond-pointed tool (to be used in the machine-shop course), is plain in its appearance; but the main point is the tempering of the piece.

The second, a matching-tool, a wood-working revolving tool. The object in introducing this plain form is to show in the last lesson (tempering) how such wood-working tools as moulding, planing, and matching tools should be tempered to insure comparative success in working wood.

No. 39. *Tapers and Bevels.* (*Drawing Cast Steel.*)—The first piece, No. 39, is a cape-chisel, used for cutting grooves in iron or any other metal. It is formed from a square to an octagonal form, to give practice in changing steel, as well as iron into different shapes; but the main point is the formation of the chisel part of the piece. The second piece, No. 39, is a centre-punch, a tool in use among nearly all metal-workers.

No. 40. *Drawing and Shaping.*—The first piece, No. 40, is cast-steel offset-spring. The second, a half-elliptic spring, made of spring steel. The object in introducing the different kinds of steel for this purpose is to show the difference in methods of tempering each, one being hardened in water, the other in oil.

No. 41. *Drawing and Shaping.* (*Cast Steel.*)—A right-hand side tool, to be used in course in machine-shops.

No. 42. *Drawing and Bevelling.* (*Cast Steel.*)—A stone-drill, the correct form and temper being the main features in the piece.

No. 43. *Drawing, Punching, and Tapering.* (*Cast Steel.*)—A riveting hammer. The idea of bringing as many tools used in working iron into the course as possible has been carried out as far as consistent with the time allowed for giving a general knowledge of the manipulations. At the close of the course, hardening and tempering are explained. A set of the pieces is hardened and tempered before the class. Then each student tempers his pieces, and they are then tested to see if they are fit to do the work intended for them.

An excuse must be made for the incorrectness in the shape of some of the pieces, as they are the forms made by the students; but I think an impartial judge would allow that they will compare favorably with work done daily by blacksmiths with as many years' experience as the student has had days.

The use of stocks and dies for screw-cutting, and drills, countersinks, etc., is taught also.

DESCRIPTION OF COURSE IN VISE-WORK.

A given time is allowed for the completion of each piece. If a student completes his work within the given time, he is allowed to take the next piece, or make any article he chooses, to use up the time allowed for the lesson. Each lesson in filing is varied in such a manner as to insure the introduction of the different shaped files, and their application to the varied forms.

The machine and filing course, occupying the same plate without regard to their precise order, must necessarily be followed by number, without regard to position.

The pieces intended for filing are planed in order to remove the rough scale so detrimental to files. The pieces, however, are planed out of true, in order to have the student bring the piece to perfection by the use of the file.

Lesson 1. No. 17. *Filing to Line.*—A plain block of cast iron, a certain amount of which is filed off true to given lines struck off by the planer. In this piece the

student is taught how to regulate the movement of the file in order to produce a true surface, with the assistance of a straight edge.

LESSON 2. No. 17.—The side and end are filed square with first true surface, a steel square being used to assist in its formation.

LESSON 3. No. 18. *Cast Iron.*—On one side of piece No. 17 a half hexagonal form is laid out and lined in the vise by the student, and finally finished in that form with the file. In this case the one block is made to do service in the three lessons, saving time and material.

LESSON 4. No. 19. *Cast Iron.*—The object of this piece is to show the different shaped files used in making rack-teeth This lesson shows how any sharp-bottomed piece can be formed, aside from the rack.

LESSON 5. No. 20. *Dovetailing.* (*Wrought Iron.*)—This piece introduces drilling, sawing, chipping, and filing. The difference and method of working the two materials, cast and wrought iron, are brought out in this lesson, comparing the method of finishing with the last lesson.

LESSON 6. No. 21.—A cast-steel wrench, made in forging course introduces inside and outside curve-filing, square hole filed from a round one, also draw-filing.

LESSON 7. No. 22. *Parallel Fitting Tongues and Grooves.*—An iron casting, lined out by the student and fitted in the form represented; the perfection of which is a good indication of the progress made after the few lessons already taken.

LESSON 8. No. 23. *Freehand Filing, with use of Hand-Vise.*—A round cast-steel piece reduced in diameter its entire length, and filed at one end to a tapering point; the main feature in the piece being a true taper, and having the point in the centre of the body.

LESSON 9. No. 25.—Comes under the same heading as last number. This piece is reduced the whole length in diameter; then a given portion is reduced still more, in order to form a shoulder on the piece, making what is termed a screw-blank. (Material, cast steel.)

LESSON 10. No. 24.—Classed the same as last two numbers. Is a piece of cast steel (round) filed into the shape of an acorn, from memory, by the student.

LESSON 11. No. 26. *Ring-Work. Freehand Filing.* (*Cast Iron.*)—The blank to the right of the number shows the piece before filing; the one to the left is the finished form. The first form is square around the ring, and finally finished into a round form.

LESSON 12. No. 27. *Chipping Bevels.* (*Cast Iron.*)—The first form is a plain block, lined upon the planer the distance from the edge intended for the bevel. This piece introduces the use of the flat cold-chisel.

LESSONS 13, 14, and 15. No. 28.—Upon this one block (wrought iron) we introduce key-way or key-seat chipping, half-round chamfering, convex and concave chipping, involving the use of cape-chisels, half-round and flat chisels, and shows the difference in treatment of the two materials ; viz., cast and wrought iron. By making one block serve for the three lessons, it saves time, stock, and room.

LESSON 16. No. 29. *Drilling, Chipping, and Filing to Line.*—A planed flat piece of cast iron upon which is laid out or lined an oval shape. All that can be drilled out of it is next done, and the stock remaining within the lines is then chipped and filed to the line.

LESSON 17. No. 30. *Ward-Filing and Key-Fitting.*—A key-blank is taken for this purpose, and filed to given dimensions, and afterwards fitted to the lock.

LESSON 18. No. 31. *Screw-Filing.*—The object of this lesson is to show how a screw can be cut with a file, when the lathes or stocks and dies are not available.

LESSON 19. No. 32. *Scraping.*—The three pieces together with the scraping-tool below them, No. 33, show what is necessary to produce a true surface by this method.

No. 33 is a very fine piece of forging and tempering, forged and finished in the filing course, and not set down in the forging course, by mistake.

DESCRIPTION OF THE COURSE IN MACHINE-TOOL WORK.

LESSON 1. A screw-cutting or engine lathe is taken to pieces, and each particular piece, used in the construction of the tool, is described in order that the class may be made familiar with it before using it, and by this means expensive machinery may be saved from unnecessary damage.

LESSON 2. *Centring, Squaring Ends, Roughing and Finishing Chip.* (*Cast Iron.*)—The piece of cylindrical form is first trued up, afterwards centre-drilled, countersunk, squared up on the ends, and then a roughing and smoothing chip.

LESSON 3. *Taper Turning.* (*Cast Iron.*)—The first piece numbered on the cut is turned two different tapers. The stock of the last lesson is used in this, to save the time centring and squaring up: consequently the first piece, Lesson 2, does not appear upon the cut.

No. 4. *Turning Flat Pieces upon the Edges.*—This piece, a flat chuck-drill, intended for use on piece No. 5, shows how flat pieces can be turned on the sides and chamfered on the ends, and also made into a tool.

A rough wrought-iron piece of cylindrical form centred, etc., as in the case of the preceding piece, but wholly differing in the manner of working it. In this lesson we introduce the tools required for turning and boxing wrought iron (differing considerably in form from the tools used in working cast iron); namely, the diamond-pointed tool, side tools, right and left twist-drill, flat chuck-drill (with its rest), taper reamer, screw-cutting tool, round-nosed or spoon-shaped tool, parting or cutting-off tool.

The introduction of various auxiliary tools, such as the centre rest, forked centre, square centre, etc., gives a great amount of practice in wrought iron working in this one piece. In this piece may be found centre rest chucking, the different forms of bearings in use, taper fitting, outside screw cutting, drilling through the piece at the end of the taper fit, convex and concave turning with engine and hand or speed lathes, and use of tools accompanying the last-named lathe.

No. 6. *Chucking, Inside Screw Cutting, etc.*—This piece is fitted to the screw cut upon the last piece, showing the uses of the boring-tool, recessing or inside cutting-off tool, on the outside of the piece. The tools described in the former lessons are brought in play, slightly altered to suit the material (cast iron), also the method of facing up the plate of iron in order to make it true, and showing how to lay out and drill holes at equal distances from one another upon a given circle.

No. 7. *Pulley Chucking, Turning, Reaming, etc.*—A driving fit, crown turning, squaring, and filing with speed, are introduced in this piece. Accompanying it, and driven through the centre of the piece, is an arbor upon which the pulley is turned. This arbor, like the one No. 13, is made of steel annealed first, and tempered when the ends are finished; finally the body is turned to fit the pulley, and by this method insuring the truthfulness of the arbor for a longer period on account of the ends being tempered.

No. 8. *Bolt-Turning, and Screw-Cutting outside.*—This piece, made in the forging course, is used here to show how this form can be finished with more accuracy than by the methods in general use, such as stocks and dies, screw-cutting machines, bolt-cutters, etc. It is only intended for true fitting, too expensive a method for rough purposes, but invaluable for service in first-class machinery. The tapping of the nuts by the machine-tap, and finishing of the nuts, are also brought in in this lesson.

No. 9 shows the turning and fitting of shafting coupling, or any piece where a driving or running fit is required. Key-seat cutting, splining, key-fitting, etc., with the use of planer, hand-splining tools, etc., for this purpose.

No. 10 introduces the use of the planer in fitting the two parts of the box and bottom of the piece, termed a pedestal or pillar block. The lesson also shows how

the bolt-holes should be laid out and drilled in order that the bolts should have a proper bearing in connecting the cap and bottom of the box, so as to make a substantial bearing for the introduction of the main feature of the lesson; viz, a boring-bar, a tool used for boring engine-cylinders, etc. In this piece although upon a small scale, is carried out each part'cular point required on a larger scale.

No. 11. *Brass-Turning.*—In this single piece the uses of the various tools for outside turning, at the same time the reverse tools for inside turning, are explained. The main point in the lesson is to show the great difference in the shape of the tools required for use upon the softer metals.

Nos. 12, 13, 14, 15, and 16 are pieces worked out in the Universal Milling Machine.

The uses of the index-head, gear-cutting, straight and bevelled, the many-sided forms that can be cut with the help of the index-head, spiral cutting, use of vise attached to the machine, etc ,—all the movements necessary to accomplish any of the pieces,—are executed by the students before actual work is commenced. By this means they become familiar with the working of it, and consequently have more confidence in themselves, and are less liable to damage the machine or tools.

Nos. 12 and 16 represent gear-cutting.

No. 13.—An arbor used in connection with No. 15 in spiral cutting.

No. 14.—A piece of plain milling, six sided on one end and seven upon the other.

No. 15.—A piece of spiral cutting.

Many other pieces are drawn in, such as fluting reamers, taps, etc.

After acquiring a knowledge of the use of the tools by this method, the student takes in hand a piece or machine of his own design,—for instance, a lathe, steam-engine, etc.,—thus showing how easily this method can be applied to construction.

With this closes the present course of instruction in use in the machine-shop.

It has been supposed that these elementary shop courses could not be so conducted as to give the students much notion of any specific applications in construction; but any one who will study Mr. Foley's report carefully will, I think, come to a different conclusion."

In a letter dated June 11th, 1883, enclosing the accompanying plan of the new Mechanic Art Shop Building, and the notes commenting upon the school, which follow here, Professor Runkle, remarks in relation to the general subject to which this Part of the Special Report is devoted:

* * *. "I have long wished that some one well qualified for the task would take up the philosophical side of all art education, and give all teachers as well as the public the true view in regard to it.

While it is true that public opinion is rapidly settling down upon the point that some modifications of our educational system is needed, there seems to be a wide diversity of opinion as to the way of securing the needed changes with the least harm to the continuity of our present educational work. How can we best modify so as to adapt to present conditions?

Wishing you all success in your important labors,

I am, very truly yours,

J. D. Runkle."

To Col. I. Edwards Clarke.

"The Mechanic Art School of the Massachusetts Institute of Technology has entirely outgrown its temporary shop building erected at its establishment in 1876. The new building of which we give a ground plan is 120 by 154 feet. The front portion, 40 by 120, is two stories high, and is to be used for class and drawing rooms;

the remainder of the building, only one story in height, is devoted to the several shops.

The scope and plan of the school have not been changed since the date of the paper in the forty fifth annual report of the Secretary of the Massachusetts Board of Education in which will be found a pretty full statement concerning it. It is quite certain however that during the coming year its course of study and shop work will be extended to three years. During the present two years there is only sufficient time to take the students over the several preliminary or the fundamental shop courses, leaving no time for them to emphasize such portions as may seem desirable, nor to make specific applications in constructions of the principles learned during the preliminary instruction. To accomplish these ends, as well as to enlarge the course of theoretical or purely mental studies, a third year is to be added. When this is done, and the school can have the advantage of more commodious shops and class rooms, the stimulus of larger numbers of older and more advanced pupils, and of a wider range of application, it will be able to furnish not only better trained and qualified men to enter upon the various industrial pursuits, but what is just now of even more importance, a class of young men well qualified to take positions as teachers in all schools desiring to give this kind of instruction.

In the report of the President of the Massachusetts Institute of Technology for 1876 will be found a paper on the Russian system of shop instruction as developed and carried out in the Imperial Technical School Moscow. In this paper attention is asked to the fundamental distinction between an art and a trade, and a few of the reasons are given why the art idea, and not the trade, should be made the foundation in any system of manual training. This paper also lays out the plan of the Mechanic Art School of the Institute as it has been carried on since that time.

The Forty-first Annual report of the Secretary of the Massachusetts Board of Education contains a paper on the "Manual Element in Education," in which the educational value of hand instruction is more fully stated and illustrated by the system adopted in the Mechanic Art School of the Institute. This paper also shows that there are three distinct steps to be taken in shop instruction in order to secure the best educational results."

The following statement of the conditions of admission and of the schedule of studies is from the 18th annual catalogue of the Institute of Technology for 1882-'83:

"Applicants for the regular course must be at least fifteen years of age, and must pass a satisfactory examination in Arithmetic, Geography, and English Composition.

The tuition is $150 a year, with no extra charge for the use of tools, or materials, used in the regular exercises. Special students, taking the same amount of shop work only as the regular class shop work, will be charged less. The student is entitled to the products of his work. A monthly return of absences is made to the parent or guardian."

FIRST YEAR.

First Term.—Shop Work,—Carpentery. Algebra commenced. English Composition. Mechanical and Freehand Drawing.

Second Term.—Shop Work,—Wood Turning, Pattern Making, Foundry Work. Plane Geometry. English Composition. Mechanical and Freehand Drawing.

SECOND YEAR.

First Term.—Shop Work,—Forging. Algebra completed. Elementary Physics. English Composition. Mechanical Drawing. French.

Second Term.—Shop Work,—Vise Work, Machine Tool Work. Geometry. Physics. English Composition. Mechanical Drawing. French Drawing.

The Massachusetts Charitable Mechanics' Association offers to sons of present or past members, two scholarships each entitling the student "to free tuition in the School of Mechanic Arts."

The catalogue shows an attendance of 57 students in the School of Mechanic Arts.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY. SCHOOL OF MECHANIC ARTS.

FRANCIS A. WALKER, PH. D., LL. D., *President.*
Clarence W. Fearing, A. M., Instructor in the School of Mechanic Arts.
Charles L. Adams, Instructor in Drawing in the School of Mechanic Arts.

WORKSHOPS.

Thomas Foley, in charge of Iron Work.
George Smith, in charge of Wood Work.
Arthur W. Sanborn, assistant in Iron Work.
Zachariah Nason, assistant in Wood Work.

The Twenty-First Annual catalogue of the Massachusetts Institute of Technology (1885–86) thus characterizes the School of Mechanic Arts. (See page 112.)

"A subordinate School of Mechanic Arts has been established by the Corporation of the Institute, in which special prominence is given to handwork in connection with high-school studies, affording an opportunity to such students as have completed the ordinary grammar-school course to continue the elementary scientific and literary studies, together with mechanical and freehand drawing, while receiving instruction in the use of the typical hand and machine tools for working iron and wood.

"The general plan of the school is similar to that of the Imperial Technical School of Moscow, the Royal Mechanic Art School of Komatau in Bohemia, the École Municipale d'Apprentis of Paris, or that of the Ambachtsschoole of the principal cities of Holland, but has been specially adapted to the somewhat different conditions existing in our own country. The object is not to fit the pupil for a particular trade, but to develop the bodily and mental powers in harmony with each other, and with reference to the actual wants of life. The handwork is done without regard to pecuniary profit, but is designed to give the student good judgment, self-reliance, and executive power, pieces practically useful being introduced when it can be done without detriment to the systematic arrangement of the courses. Its exact and systematic method affords the direct advantage of training the hand and eye for accurate and efficient service with the greatest economy of time, and the instruction in the use of tools and materials has also proved a valuable aid in intellectual development.

"The school occupies a building on Garrison street, a short distance from the Rogers Building. The facilities for instruction are ample and increasing; and the mechanical laboratories, in which the instruction in the mechanic arts is given have a thorough equipment (see p. 46)."

The following is the list of the apparatus provided for the use of the pupils in this department of the Institute:

"The carpenter, wood-turning, and pattern-making departments contain 40 carpenters' benches, 2 circular-saw benches, a swing-saw, 2 jig-saws, a buzz-planer, a boring-machine, 36 wood-lathes, a large pattern-maker's lathe, and 36 pattern-maker's benches. The foundry contains a cupola furnace for melting iron, 2 brass

furnaces, and 32 moulder's benches. The forge shop contains 32 forges, 7 blacksmith's vises, and 1 blacksmith's hand-drill. The machine-shop contains 22 engine-lathes, and 15 hand-lathes of recent approved patterns, a machine-drill, 2 planers, a shaping-machine, a universal milling-machine, a grinding-lathe, and 32 vise-benches arranged for instruction in vise-work."

It will be seen by comparison with the account of the early equipment that the facilities have been largely increased in the new building.

The following summary of attendance for the year is given.

Summary: School of Mechanic Arts.

Regular Students, 2d year	12
" " 1st "	12
Special "	36
Total	60

The following is the list of the faculty of the school as given in the 22nd Annual Catalogue (1886–'87.)

OFFICERS OF INSTRUCTION.

FRANCIS A. WALKER, LL.D., *President.*

Peter Schwamb, S.B., Director.
Clarence W. Fearing, A.M., Instructor in English and Mathematics.
Charles L. Adams, Instructor in Drawing.
William H. Pickering, S.B., Instructor in Physics.
George T. Dippold, Ph.D., Instructor in French.
Charles H. Stephenson, Instructor in Machine-Tool Work.
Theodore B. Merrick, Instructor in Wood-work and Foundry-work.
James R. Lambirth, Instructor in Forging.
James G. Langdon, Assistant in Wood-work.
Robert H. Smith, Assistant in Machine-Tool work.
Herbert W. Adams, Assistant in Drawing.
John W. Raymond, Jun., Assistant in Forging.
Special instruction is given also by members of the Faculty of the School of Industrial Science.

Summary: School of Mechanic Arts.

Regular Students, 2d year	7
" " 1st "	15
Special "	16
Total	38

The 23rd Annual Catalogue 1887–'88, contains the following notice of the school. The concise brevity of the statement, in contrast with the fuller descriptions given in previous catalogues, may serve as an indication of the rapid increase of similar schools throughout the country; since a general knowledge of their characteristics seems here to be taken for granted.

This school, established by the Corporation in 1876, is essentially a High School, with some of the familiar studies replaced by extended instruction in mechanical

and freehand drawing, and in carpentery, wood and iron turning, pattern making, forging, chipping and filing, etc. (see p. 52.) The course of study is of two years' duration, the minimum age of admission being fifteen years, and the requirements for entrance embracing the ordinary studies of a good grammar school. The tuition fees are $150 a year. The school is in charge of Mr. Clarence W. Fearing, instructor in mathematics and English, instruction in the remaining studies being given by some of the instructors in the School of Industrial Science (see p. 12.)"

The register of students attending the several classes of the school, gives a total of 37.

The 26th annual catalogue for 1890–1891* refers as follows to the school, which evidently for the past few years has been gradually relegated, from being as at first a special feature of interest, to a subordinate and incidental part in the general educational plan of the Institute, somewhat as has happened to the preparatory School commonly attached as a feeder to the newly established college, which, though (in each case) at first regarded as a somewhat important feature of the young college, is gradually subordinated; till, finally, as the college grows in strength it is excised altogether and ceases to belong to the institution.

The following brief notice of the School is found on page 79 of the catalogue.

"THE INSTRUCTION IN SHOPWORK.

Practical instruction in the nature of the materials of construction, and in the typical operations involved in the Arts, is considered a very valuable adjunct to the theoretical treatment of professional subjects. Workshops have been provided and furnished with the more important hand and machine tools, so that the student may acquire a direct knowledge of the nature of metals and woods, some manual skill in the use of tools, and a thorough knowledge of what can be accomplished with them. The shops are located in the building on Garrison Street, and are equipped as follows":—

The statistics of the equipment being the same as already quoted from the 21st report, are here omitted. The register of special students shows that 76 took shop-work.

The growth and development of the Institute of Technology in its advanced courses, a development which entitles it to rank with the leading Scientific and Technical Schools of the world, and which fully justifies the subordination of the Manual Training School, especially since this has so well served its purpose as a pattern for similar schools throughout the country, is tersely set forth in President Walker's Special Report of December 9th, 1890.†

* Massachusetts Institute of Technology, Boston. Twenty-Sixth Annual Catalogue of the officers and students, with a statement of the courses of instruction and a list of the alumni. 1890-1891. John Wilson and Son, University Press, Cambridge 1890. Pp. 219.

† Annual Report of the President and Treasurer of the Massachusetts Institute of Technology, December 10, 1890. Boston: Alfred Mudge & Son, Printers, 24 Franklin Street, 1891. Pp 67.

He is urging the claim of the Institute to a larger share of the National fund given to the Land Grant Colleges and in Massachusetts divided between the Agricultural college at Amherst, and the Institute of Technology at Boston. He says:

"At the time the Act of April 27, 1863, was passed, the Institute of Technology existed only upon paper. Its future was necessarily involved in grave uncertainty. The person then most confident of success could not possibly have anticipated such a development of its influence as has taken place. It might not unreasonably have been anticipated that its students would always remain few, and that its relations to the industries of the Commonwealth would be narrowly restricted within the familiar limits of civil engineering, and perhaps also of chemistry. Under the circumstances, the proportions established by the Act of 1863—two-thirds to the Agricultural College, one-third to the Institute of Technology—may be regarded as not unfair.

Within the twenty-seven years that have elapsed since the date of the Act referred to, however, this School of Industrial Science has grown into dimensions then inconceivable, and it has connected itself with the industrial life of Massachusetts in ways then unknown. Professions not named in 1863 have come into being, and have risen to transcendent importance, while the development of industrial science throughout the world, to which no single institution has contributed more than this our own school, has created demands which were not then felt. If Massachusetts would hold her proud pre-eminence in manufactures, she must do it by force of knowledge and technical skill, since her natural disadvantages in respect to transportation and the possession of the materials of production are weighing all the time more and more heavily against her. The Institute of Technology is, in spite of its large tuition fees, still painfully poor in relation to its needs. Without disparagement to any, it may be said that in no other way can Massachusetts so largely aid herself as by increasing the means of this institution available for chemistry, mechanics, and electricity."

The Manual Training School of Washington University, St. Louis, Missouri.

The following account of the origin of this well known School and of its development down to the year 1883 was prepared by Professor Woodward for this Report as already stated.

The Manual Training School of Washington University, St. Louis.

"After several years' experience in combining tool-instruction with ordinary class-room work in the Polytechnic School the students being of Collegiate rank, it was suggested by Prof. C. M. Woodward that tool-instruction could be introduced with success into a school of lower grade taking boys as young as fourteen years of age. Accordingly, a plan was drawn up and endorsed by certain merchants and manufacturers who subscribed the requisite funds.

The Ordinance establishing the Manual Training School, was adopted by the Board of Directors of the University, June 6, 1879.

The lot was purchased and the building fronting on Eighteenth street begun in August of the same year. In the November following a Prospectus of the school was published. In June, 1880, the building being partially equipped, it was opened for public inspection, and a class of boys were examined for admission. On September 6, 1880, the school opened with a single class of about fifty pupils. The whole number enrolled during the year was sixty-seven. A public exhibition of drawing and shopwork was given June 16, 1881.

The *second year* of the school opened September 12, 1881, and closed June 14, 1882. There were two classes, sixty-one pupils belonging to the first-year, and forty-six to the second-year, making one hundred and seven in all.

During the summer of 1882 the large addition was built and furnished, about doubling the capacity of the school and greatly increasing the convenience with which all work could be done.

The *third year* of the school opened September 11th, 1882, with three classes enrolling in all 175 pupils.

Two Articles of the Ordinance establishing the school are appended.

ARTICLE II.

Its object shall be instruction in Mathematics, Drawing, and the English branches of a High School course, and instruction and practice in the use of Tools. The Tool-instruction, as at present contemplated, shall include Carpentry, Wood-Turning, Pattern-Making, Iron Clipping and Filing, Forge-Work, Brazing and Soldering, the use of Machine-Shop Tools, and such other instruction of a similar character as it may be deemed advisable to add to the foregoing from time to time.

The students will divide their working hours, as nearly as possible, equally between Mental and Manual Exercises.

They shall be admitted, on examination, at not less than fourteen years of age, and the course shall continue three years.

ARTICLE IV.

The expenses of said school shall be provided for, so far as possible, by gifts and endowments specially contributed for the purpose, and all such gifts and endowments shall be held sacred and apart, and shall be used only for the direct purposes for which they may have been given, unless by consent of the respective donors or their legal representatives.

The cost of the present building was about $33,000. The cost of tools and furniture was about $16,000.

The lot upon which the building stands is 106⅓ feet by 150 feet.

It is proposed to admit a new class of 100 boys every year. With the inevitable falling off incident to the higher classes it is not expected the maximum attendance will exceed 240 pupils.

CONDITIONS OF ADMISSION.

Candidates for admission to the first-year class must be at least fourteen years of age; they must pass a good examination on the following subjects:

1. *Arithmetic;* including the fundamentnl rules; common and decimal fractions; the tables of weights, measures, and their use. Candidates will be examined orally in mental arithmetic, including fractions and the multiplication table up to twenty.
2. Common School Geography.
3. Spelling and Penmanship.
4. The writing of English.

THE COURSE OF INSTRUCTION

Covers three years, and the school time of the pupils is about equally divided between mental and manual exercises. The daily session begins at 9 A. M., and closes at 3.20 P. M., ample allowance being made for lunch. One hour per day is given to drawing, and two hours to shop-work.

The course of study embraces five parallel lines—three intellectual and two manual—as follows:—

First—A course of pure Mathematics, including Arithmetic, Algebra, Geometry, and Plane Trigonometry.

Second—A course in Science and Applied Mathematics, including Physical Geography, Natural Philosophy, Chemistry, Mechanics, Mensuration, and Book-keeping.

Third—A course in Language and Literature, including English Grammar, Spelling, Composition, Literature, History, and the elements of Political Science and Economy. Latin and French will be introduced as electives with English if desired.

Fourth—A course in Penmanship, Free-Hand and Mechanical Drawing.

Fifth—A course of Tool instruction, including Carpentry, Wood-Turning, Forging, Soldering and Bench and Machine Work in Iron.

The course in Drawing embraces three general divisions:

1. *Free-Hand Drawing*, designed to educate the sense of form and proportion; to teach the eye to observe accurately, and to train the hand to rapidly delineate the forms either of existing objects or of ideals in the mind.

2. *Mechanical Drawing*, including the use of instruments; geometric constructions; the arrangement of projections, elevations, plans and sections; also the various methods of producing shades and shadows with pen or brush.

3. *Technical Drawing or Draughting*, illustrating conventional colors and signs; systems of architectural or shop-drawings; and at the same time familiarizing the pupil with the proportions and details of various classes of machines and structures.

Students have no option or election as to particular studies; each must conform to the course as laid down, and take every branch in its order.

No student will be allowed to take shop-work in advance of his class.

The arrangement of studies and shop-work by years is substantially as follows:

COURSE OF STUDY.

FIRST-YEAR CLASS.

Arithmetic, completed. *Algebra*, to Equations.
English Language, its Structure and Use. *History* of the United States.
Latin may be taken in place of *English* and *History*.
Physical Geography. *Natural Philosophy* begun.
Drawing, Mechanical and Free-hand. *Penmanship*.
Carpentry and Joinery. *Wood-Carving*. *Wood-Turning*. *Pattern-Making*.

SECOND-YEAR CLASS.

Algebra, through Quadratics. *Geometry* begun.
Natural Philosophy. *Principles of Mechanics*.
English Composition and Literature. *English History*.
Latin may be taken in place of *English and History* if desired by a division of the class.
Drawing, Orthographic and Isometric Projections, Lettering, Details of Machines, Tinting, *Free-hand* Drawing. *Penmanship*.
Forging.—Drawing, Upsetting, Bending, Punching, Welding, Tempering. Soldering.

THIRD-YEAR CLASS.

Geometry, finished. *Plane Trigonometry and Mensuration*.
English Composition and Literature. *History*. *Ethics* and *Political Economy*.
Elements of Chemistry.
Book-keeping.
Drawing, Machine and Architectural. *Elements of Descriptive Geometry*.
Work in the Machine Shop. Bench Work and Fitting, Turning, Drilling, Planing, Screw-cutting, etc. *Study of the Steam Engine*.

Execution of Project.

French or *Latin* may be taken in place of *English* and *History.*

Before receiving a diploma of the school, each student must execute a project satisfactory to the faculty of the school. The project consists of the actual construction of a machine. The finished machine must be accompanied by a full set of the working drawings according to which the machine is made. If it is not feasible to construct the patterns for castings of such machine, proper directions for their construction must accompany the drawings.

Diplomas.—Pupils completing the course are presented with appropriate diplomas. Occasionally medals are given as evidence of special excellence in certain branches.

Tuition Fees.—The school year consists of two terms of twenty weeks each. The fees are

First-year class, per year	$60.00
Second-year " " "	80.00
Third-year " " "	100.00

Scholarships.—The founders of the school desire that the advantages of this school shall be within the reach of boys from every class in the community. A limited number of free scholarships are therefore filled annually. It is desirable that they should in general be given as rewards of merit to promising boys in straitened circumstances.

Students, whether on scholarships or not, furnish their own books, drawing instruments, paper and boards; their own aprons and overalls; and their own pocket tools. The school furnishes shop-tools and materials. Losses and breakages are charged to pupils when they are the result of carelessness.

Daily Programme.

Class.	Division.	9 a. m.	11 a. m.	11 a. m.	1 p. m.	1-1:20 p. m.	1:20 p. m.	3:20 p. m.
Third year.	A.	Physics or Mathematics.	English history.	Machine Shop.		Recess.	French.	Drawing.
	B.	Chemistry.	Mathematics.	Political Economy.	Drawing.		Machine Shop.	
Second year.	A.	Blacksmith Shop.		Geometry.	Rhetoric.		Drawing.	Mechanics.
	B.	Algebra.	Drawing.	Blacksmith Shop.			Mechanics.	Rhetoric.
First year.	A.	Turning Shop.		Drawing.	Physics.		Algebra.	History.
	B.	Drawing.	Latin.	Algebra.	Physics.		Turning Shop.	
	C.	Algebra.	Drawing.	Turning Shop.			Latin.	Physics.
	D.	Turning Shop.		Drawing.	History.		Physics.	Algebra.
	E.	History.	Physics.	Arithmetic.	Drawing.		Turning Shop.	

Every class has an exercise in Literature, Composition, or Spelling once a week.
Recitations are an hour long in the third-year class; in the other classes, forty minutes.

C. M. WOODWARD,
Director.

THE PURPOSE OF THE SCHOOL.

The Manual Training School is not an asylum for dull or lazy boys. It clearly recognizes the pre-eminent value and necessity of intellectual development and discipline. In presenting some novel features in its course of instruction, the managers do not assume that in other schools there is too much intellectual and moral training, but that there is too little manual training for ordinary American boys. This school exacts close and thoughtful study with books as well as with tools. It proposes, by lengthening the usual school-day a full hour, and by abridging somewhat the number of daily recitations, to find time for drawing and tool-work, and thus to secure a more liberal intellectual and physical development—a more symmetrical education.

It is believed that, to all students, without regard to plans for the future, the value of the training which can be got in shop-work, spending only eight or ten hours per week, is abundantly sufficient to justify the expense of materials, tools, and teachers.

THE DEVELOPMENT OF NATURAL APTITUDES.

It occasionally happens that students who have special aptitudes in certain directions, find great difficulty in mastering subjects in other directions. In such cases it is often the best course to yield to natural tastes, and to assist the student in finding his proper sphere of work or study. A decided aptitude for handicraft is not unfrequently coupled with a strong aversion to and unfitness for abstract and theoretical investigations. There can be no doubt that, in such cases, more time should be spent in the shop, and less in the lecture and recitation room. On the other hand, great facility in the acquisition and use of language is often accompained by a great lack of either mechanical interest or power. When such a bias is discovered, the lad should unquestionably be sent to his grammar and dictionary rather than to the laboratory or draughting-room. It is confidently believed that the developments of this school will prevent those serious errors in the choice of a vocation which often prove so fatal to the fondest hopes.

One great object of the school is to foster a higher appreciation of the value and dignity of intelligent labor, and the worth and respectability of laboring men. A boy who sees nothing in manual labor but mere brute force, despises both the labor and the laborer. With the acquisition of skill in himself, comes the ability and willingness to recognize skill in his fellows. When once he appreciates skill in handicraft, he regards the workman with sympathy and respect.

In a Manual Training School, tool-work never descends into drudgery. The tasks are not long, nor are they unnecessarily repeated. Whatever may be the social standing or influence of the fathers, the sons go together to the same work, and are tested physically as well as intellectually, by the same standards. The result in the past has been, and in the future it will continue to be, a truer estimate of laboring and manufacturing people, and a sounder judgment on all social problems.

It is not assumed that every boy who enters this school is to be a mechanic. Some will find that they have no taste for manual arts, and will turn into other paths—law, medicine or literature. Some who develop both natural skill and strong intellectual powers will push on through the Polytechnic School into the higher realms of professional life, as engineers or scientists. Others will find their greatest usefulness as well as highest happiness in some branch of mechanical work into which they will readily step when they leave school. All will gain intellectually by their experience in contact with *things*. The grand result will be an increasing interest in manufacturing pursuits, more intelligent mechanics, more successful manufacturers, better lawyers, more skillful physicians, and more useful citizens.

SCHOOL BUILDING AND ACCOMMODATIONS.

A perspective view of the school building is given and the arrangement of the three floors is shown in the accompanying cuts. It will be noticed that the original building, which was used for the first two years of the school, is now wholly devoted to the interests of the shop work, while all needed study, recitation, and drawing rooms are supplied in the recent addition.

As a rule, each shop has uniform accommodations for a class of twenty pupils. Three such classes or divisions can be taught daily in each. Four divisions could be taught by extending the range of a school day to eight hours. Each pupil in the wood-working shops has one of the uniform sets of hand edge-tools for his exclusive use, kept in a locked drawer. For the care and safety of these tools he is held responsible.

I.—THE TWO CARPENTER SHOPS.

For details of these shops, each 40×50 feet, see cuts of second and third floors. The third-story shop is used both as a carpenter and as a turning shop. Each contains twenty benches, vises, and sets of tools for use in common, a power grindstone, the instructor's desk and bench, and the requisite quota of clamps, glue-pots, etc. The school has over one hundred sets of edge-tools marked for the several drawers. A double circular-saw machine is provided for getting out stock ("blanks" for a class).

II.—THE TWO TURNING SHOPS.

One is 40×50 feet, and the other 40×40 feet. Each contains twenty speed-lathes of 12-inch swing and 5-foot bed, with complete equipment of face-plates, chucks, etc., for one hundred pupils. Each shop contains several 8-foot benches for pattern work, a power grindstone, and a moulder's bench and tools for illustrating practically the use and handling of patterns for foundry work.

III.—THE BLACKSMITH SHOP.

The first floor of the building is devoted to metal work, and comprises the machine and blacksmith shops. The blacksmith's shop is 40 feet square, and has its complete equipment of twenty forges, anvils, tubs, and sets of ordinary hand tools. Ten sets of heavy tools suffice for twenty pupils, as they may work in pairs as smith and helper. The blast is supplied by a fan blower, and a powerful exhaust fan keeps the shop almost wholly free from smoke and gas. In connection with one of the larger forges is a hand-bellows, which can be used when the engine is not running. Every shop exercise lasts two hours, consequently the shop readily accommodates eighty pupils per day.

IV.—THE MACHINE SHOP

Is 40×50 feet. It possesses an equipment of seven engine-lathes of 14-inch swing and 5-foot bed (It is proposed to add several new lathes during the summer, so that class work may be more uniform); four speed-lathes; a post drill; a planer, 21-inch by 21-inch by 5 feet; a 25-inch goose-neck drill; a shaper of 15 inches stroke; and a large power grindstone. Ten vises and benches, with forty drawers, afford opportunity for bench work. The shop is furnished for a class of twenty students at once. The Corliss engine occupies a part of this shop. It has a 14-inch cylinder and 42-inch stroke, and runs at the rate of 65 revolutions per minute. The engine is of the best pattern and superior workmanship, and is capable of about sixty horse-power. It was built specially for the school by Messrs. Smith, Beggs & Rankin, of St. Louis. The steam-generating apparatus of the University consists of a battery of three

large steel boilers, set and furnished in the most approved manner. These boilers furnish heat for the entire group of University buildings, as well as steam for the engine in the shop. This equipment of steam power furnishes to pupils of the Third-Year class the means of becoming familiar with such machinery on a scale unsurpassed.

HOW THE USE OF TOOLS IS TAUGHT.

The shop instruction is given similarly to laboratory lectures. The instructor at the bench, machine, or anvil, executes in the presence of the whole class the day's lesson, giving all needed information, and at times using the blackboard. When necessary the pupils make notes and sketches (working drawings), and questions are asked and answered, that all obscurities may be removed. The class then proceeds to the execution of the task, leaving the instructor to give additional help to such as need it. At a specified time the lesson ceases, and the work is brought in, commented on and marked. It is not necessary that all the work assigned should be finished; the essential thing is that it should be well begun and carried on with reasonable speed and accuracy.

SPECIAL TRADES ARE NOT TAUGHT.

All the shop-work is disciplinary; special trades are not taught, nor are articles manufactured for sale.

The scope of a single trade is too narrow for educational purposes. A shop which manufactures for the market, and expects a revenue from the sale of its products, is necessarily confined to salable work, and a systematic and progressive series of lessons is impossible, except at great cost. If the object of the shop is education, a student should be allowed to discontinue any task or process the moment he has learned to do it well. If the shop were intended to make money, the students would be kept at work on what they could do best at the expense of breadth and versatility.

In manual education, the desired end is the acquirement of skill in the use of tools and materials, and not the production of specific articles; hence we abstract all the mechanical processes and manual arts and typical tools of the trades and occupations of men, arrange a systematic course of instruction in the same, and then incorporate it in our system of education. Thus, without teaching any one trade, we teach the essential mechanical principles of all.

Accordingly, the shop-training is gained by regular and carefully graded lessons designed to cover as much ground as possible, and to teach thoroughly the uses of ordinary tools. This does not imply the attainment of sufficient skill to produce either the fine work or the rapidity of a skilled mechanic. But a knowledge of how a tool or machine should be used is easily and thoroughly taught. The mechanical products or results of such lessons have little or no value when completed, and they are generally used as new material for more exercises.

Frequent requests have been made for detailed descriptions or drawings of the models actually made in the several shops. Such requests have generally been refused for several good reasons. In the first place, the main object of one or more exercises is to gain control and mastery of the tool in hand, and not the production of a particular model. The use of the tool may be well taught by a large variety of exercises, just as knowledge of bank discount may be gained from the use of several different examples. No special merit can be claimed for a particular example; neither can a particular model or series of models have any great value. No good teacher is likely to use precisely the same set twice, The *method* of doing a piece of work, and not the finished piece, is generally the object of a lesson.

The tools of a shop are not given out all at once; they are issued as they are needed, and as a rule, to all the members of a class alike.

I.—CARPENTRY.

In carpenter work the tools used are: the cross-cut, tenon, and rip saws; steel square, try square, bevel and gauge, hammer, mallet, rule and dividers, oil stones and slips. And among edge-tools: the jack and smoothing planes, chisels, and gouges. Braces and bits, jointer planes, compass saws, hatchets, and other tools are kept in the shop tool-closet to be used as needed.

The saw and the plane with the square and gauge are the foundation tools, and to drill the pupils in their use numerous lessons are given, varied only enough to avoid monotony. The pupil being able to plane a piece fairly well, and to keep to the line in sawing, the next step is to teach him the use of the chisel in producing simple joints of various kinds. The particular shapes are given with the intent to familiarize the pupil with the customary styles and methods of construction.

The different sizes of the same tool, chisels for instance, require different care and methods of handling, and the means of overcoming irregularities and defects in material form another chapter in the instruction to be given.

With the introduction of each tool, the pupils are taught how to keep the same in order. They are taught that sharp tools are absolutely necessary to good work.

II.—WOOD-TURNING.

Five or six tools only are used, and from previous experience the pupils know how to keep them in order. At first a large gouge only is issued, and the pupils are taught and drilled in its use in roughing out and producing cylinders and cones; then concave and double-curved surfaces; then in work comprising all these—all in wood-turning with the grain. A wide chisel follows, and its use in conjunction with the gouge is taught. After this a smaller gouge, chisel, and parting tool, and a round-point are given, and a variety of shapes are executed. Next comes turning across the grain; then bored and hollow work, chucking and the various ways of manipulating wood on face-plates, mandrels, etc. Finally, turning of fancy woods, polishing, jointing, and pattern work.

In connection with the making of patterns, their use is shown by brief exercises in moulding. Castings are made of lead or type metal. Though very little moulding or casting is done by the students, enough practice is given to illustrate the principles and explain the use of technical terms.

III.—FORGING.

Work in the blacksmith shop is in one essential feature different from any other kind. Wood or cold iron will wait any desired length of time while the pupil considers how he shall work, but here comes in temperature subject to continual change. The injunction is imperative to "strike while the iron is hot," and hence quick work is demanded—a hard thing for new hands. To obviate this difficulty bars of lead are used, with which the lesson is first executed, while all the particulars of holding and striking are studied. The lead acts under the hammer very nearly like hot iron, and permits every operation on the anvil except welding.

The various operations of drawing, bending, upsetting, punching, welding, tempering, etc., are learned in connection with the fabrication of hooks, stirrups, chains, swivels, tongs, hammers, and machine tools.

One of the most difficult lessons in the art of the smith is that of managing the fire. The various kinds of heat are explained and illustrated, and habits of economy of both iron and fuel are inculcated.

At the date of the preparation of this statement arrangements had not been made for class instruction in soldering and brazing, though they were expected soon.

IV.—MACHINE-SHOP WORK.

In the machine shop, owing to the inevitable lack of tools, the class-work is less uniform. It is practically impossible to furnish a class of twenty students with twenty lathes, twenty planers, twenty drills, &c., &c. The size and cost of such a shop puts the matter out of discussion; the cost of the tools in the present shop exceeded $4,000, exclusive of the engine and shafting.

Nevertheless, the *instruction* is given with an approach to regularity; the *practice* is as uniform as the tools will allow. The course includes chipping, filing, polishing, turning, drilling, boring, screw-cutting, scraping, planing, &c., and all the details of fitting and finishing.

During the second term the members of the class, either singly or in groups, enter upon the construction of their projects for finished work.

Throughout the year a detail is made from each shop-division to study the management of the engine and boilers, under the direction of a competent engineer.

THE SKILL ATTAINED.

It cannot be claimed that the student workmen become skilled mechanics in any of the shops, though it is insisted that every step shall be clearly understood and fairly executed. The rapid progress of boys to whom all subjects are presented in logical order, with clear and full explanations, and who work under the continual guidance of an expert teacher, and only two hours at a time,—during which their interest is fully sustained—is most surprising to those who compare the work produced here with the performances of ordinary apprentices of the same number of hours.

TIME DEVOTED TO SHOP-WORK.

Two hours per day for five days gives ten hours per week. 400 hours are given to wood work. 400 hours to iron and steel forging, and soldering. 400 hours are given to bench and machine work on metals and the care of boilers and engine. Hence the total amount of shop work in the course is 1200 hours, in time equal to 120 days of ten hours each.

ORDINARY STUDIES.

It has not been thought necessary to detail the work done on the familiar subjects of mathematics, science, and literature. The simultaneous development and discipline of the intellectual and physical faculties is the main object of the course. The aim is to do thorough work; to lay out a fair course of study and cover it well. There is no laxity in book-work in consequence of the introduction of manual features in the daily programme.

REGULATIONS FOR PRACTICE HOURS IN THE WORKSHOPS.

1. When dismissed for shop work, students will go directly to the shop assigned.
2. During practice hours students must give their undivided attention to the work assigned, not leaving it to clean up till the ringing of the first bell.
3. All singing, whistling, and lounging on the benches or machines is strictly forbidden; students should talk only when it is necessary, and then in a low tone.
4. During the regular hours private work cannot be permitted. At other times such work, if of a suitable character, may be allowed, at the option of the instructor.
5. Students should clean, and return to its place, any tool taken from the tool cases, as soon as they are through using it.
6. Promptly upon the ringing of the first bell work should cease; the tools should be put in their proper places, and the bench or machine cleaned before leaving the room to wash up. Unfinished work should be put in the drawers, or in such places

as the instructor may direct. The tool-drawers should always be left clean and in order.

7. Students will be admitted only to such shops as are necessary to their work; and at the hours assigned, except by permission of the instructor.

8. When the student has finished the work assigned him, and he sees that the instructor is not engaged, he may go to him for further instructions; otherwise he will remain quietly at his place.

9. Students must promptly report to the Superintendent any loss or breakage of either tools or furniture. Losses and injuries which are the result of gross carelessness or disobedience of orders, should be paid for by the students responsible for them.

THE SUCCESS OF THE SCHOOL.

The Managers of the school are abundantly confirmed in their views, as set forth in the Prospectus four years ago, by the experience of the school during its first three years. From the start it has been well patronized, and vacant seats have been few; at times every seat has been filled.

The zeal and enthusiasm of the students has been developed to a most gratifying extent, extending into all the departments of work. The variety afforded by the daily programme has had the moral and intellectual effect expected, and an unusual degree of sober earnestness has been shown. The wholesome moral effect of a course of training which interests and stimulates the ardor of the student is most marked. Parents observe the beneficial influence of occupation. The suggestions of the day fill the mind with healthy thoughts and appetites during the leisure hours. Success in drawing or shop-work has often had the effect of arousing the ambition in mathematics and history, and *vice versa*.

Progress in the two subjects, drawing and shop-work, (and we had little previous knowledge of what could be done with boys as young as those of the first-year class) has been quite remarkable. To be sure there was little doubt of the final result, but the progress has been more rapid than it seemed reasonable to expect. The habit of working from drawings and to nice measurements has given the students a confidence in themselves altogether new. This is shown in the readiness with which they undertake the execution of small commissions in behalf of the school, and the handiness which they display at home. In fact, the increased usefulness of the students is making itself felt, and in several instances the result has been the offer of business positions too tempting to be rejected. This drawback, if it can be called one, the school must always suffer. The better educated and trained the students become, the stronger will be the temptations offered to them outside, and the more difficult it will be to hold them through the course. Parents and guardians should avoid the bad policy of injuring the prospects of a promising young man by grasping a small present pecuniary advantage at the cost of far greater rewards in the future. From the testimony of parents (and by a circular, all were invited to give frank expression to their views) the physical, intellectual, and moral effect of the school is exceedingly satisfactory. The *unanimous* response is: an unusual interest and pleasure in school; and very generally an increased fondness for scientific books and periodicals. A few boys who had never shown any interest in tools have developed into good and enthusiastic workmen. As a rule the good scholars are the good mechanics.

The following paragraphs from an account of a visit to the school which appeared in the St. Louis Republican of February 4th, 1883, convey the impression made on outsiders by this new kind of school; while in the quotations there given from the message to the Legislature by the Governor of the State, the desirableness of this new

element in the course of study is clearly set forth. General Armstrong, whose great success in new fields of educational activity entitles him to be heard as an expert, speaks very much to the purpose in what he says as to the need and the cost of such schools.

From the "St. Louis Republican" of February 4, 1883:

The novelty of the school has by no means worn off, at least to outsiders. Travellers along Washington avenue, as they pass the handsome and substantial-looking building, turn to look again at the massive fly-wheel which revolves in full view through the front windows. If one ventures inside the building, as we did recently with great satisfaction, he experiences first a feeling of surprise and strangeness, and later a sense of completeness. Mingled with what is old and familiar is much that is new and at first sight incongruous.

In class-rooms, removed from all din of tools and the vibration of machinery, are sections of eighteen or twenty boys each, reciting lessons in algebra, or history, or Latin, or physics. In the draughting rooms one section is learning line-drawing, or how to represent objects by their exact orthographic or isometric projections. Another section is making shaded drawings of actual machines.

If a visitor sees only the study, recitation and drawing-rooms, the impression made is like that produced by a high school in which comparatively little attention is paid the ancient languages and history, while special attention is paid to theoretical and practical drawing, and to elementary physic.

On crossing the hallway to the shops the scene changes. The same lads that a few moments before we saw reciting a lesson are now in "shop dress" engaged in the study and practice of tool-work. Two sections of twenty boys each were engaged at wood-turning, every man having a lathe driven by the large shop engine.
* * * * *.

Gov. Crittenden strongly indorsed this school in his recent message to the legislature of Missouri. Said he:

"The ordinary school-boy gets the idea that it requires no education to be a mechanic; hence he aspires to what is called a higher profession, a higher vocation, and foolishly learns, from vicious sources, to despise both craft and craftsman. If this pernicious tendency can be corrected, and the dignity of skilled labor and skilled workmen be maintained by the introduction of manual training into grammar schools and schools of high grade, great good will be accomplished. I have no hesitancy in directing attention to this manual school as one of our educational ornaments, worthy of the patronage of our sons and the respect of our citizens."

Gen. C. S. Armstrong of Hampton, Va., after a visit, writes in the *Southern Workman:* "The Manual Training school is no experiment. It is the nearest to perfection of the true method of training head and hand together I know of. The same plan is pursued at the Boston School of Technology, but so far as teaching trades is concerned, the St. Louis school is far ahead of the one in Boston.

"Our civilization demands this sort of thing. The trouble is that while people theoretically believe in practical education, they are not ready to throw large sums of money into it as they are with the old style colleges, which have a tremendous hold, and are not in the least experimental. People will have such schools when they are willing to pay for them. Manual training-schools are the most expensive kind. They require two sets of teachers, rare business skill, and a variety of material and of appliances of which ordinary schools never dream of. As in everything else, the better and more complete the product the more it costs. You cannot say 'Pay your money and take your choice,' but you must pay more for industrial education."

The following extracts from a letter written by Professor Woodward, Director of the school, explain themselves and are of interest.

CORRESPONDENCE.

MANUAL TRAINING SCHOOL,
St. Louis, April 24, 1883.

Editor of The Reporter :

I am asked by the editor to answer the question : "What will the Manual Training School boys do on leaving school?"

Before venturing a few words on this most interesting subject, let me say, for the sake of preventing confusion, that the Manual Training School is not the polytechnic department of the University ; and its graduates are not to be confounded with the civil and mechanical engineers, who combine with their higher scientific studies a certain amount of manual training. The Manual Training School is of a lower grade. It admits boys, on examination, as young as fourteen years, and its course of instruction extends through three years. I should add that this is but the third year of the school, and that our first class is to graduate next June ; hence I can not speak of what our boys *have done* after leaving us, but of what they now wish to do.

Now, first, I claim that our graduates will form a new article never before put upon an American market. They will stand in strong contrast to the graduates of high schools and academies, with whom they are on a fair equality as regards scholarship. * * *

A FOURTH "R."

We maintain that the "three R.'s" do not suffice. "Reading, 'Riting, and 'Rithmetic" are all very well, but they are not enough. We add at least a fourth "R," namely "*'Rtizanship!*" We propose to tear down the prison walls, to open all the doors and to clear all the avenues to intellectual, moral and material wealth. We have worshipped books till we have fancied that all wisdom and culture was bound up in them. We have bent so reverently at the shrine of the ancients that we have been made to believe that the pyramid of Jeezah, the temple of Diana at Ephesus, and the Athenian Parthenon were the product of inspired genius, while we pass over the steel arches of the St. Louis Bridge without appreciating the fact that in genius, mechanical skill, scientific accuracy, beauty and grace, it outshines them all. In languages, arts, and sciences the world of to-day surpasses all past ages; and education should mainly deal with living issues, and "*lead out*" in all directions.

CHOICE OF OCCUPATION.

Boys whose education has been well balanced will choose their occupations intelligently. They will not all travel the same road. We do not wish to repeat the old mistake. We should be sorry to see every boy of the Manual Training School become a mechanic. I know that many are not fit for it ; they will be more successful as lawyers, or editors, or buyers, or sellers. Will their manual training be therefore lost? Not at all. Just as it does not hurt a mechanic to know literature and science, so it will not hurt a lawyer or an editor to have a little common sense on mechanical and concrete matters.

BALANCED EDUCATION.

No, we do not try in our school to wall-out letters, or art, or mathematics, or the elements of science ; and hence we shall not be surprised to see our graduates traveling in various directions when they leave our doors. We shall not fetter their feet through fear of their leaping over their work-benches ; nor when they hunger and thirst for the highest cultivation the University can give, shall we refuse to minister unto them lest, for-sooth, we *teach them too much*, and they be not mechanics

after all. A symmetrical or integral education is never to be feared; it will never lead a man out of this sphere; it is only the one-sided, narrow, walled-in education which distorts, misleads and corrupts. I have claimed that our boys would be free from prejudice against manual labor; that they will appreciate mechanical skill, and if they have it, they will enjoy its practice. In general, I have claimed that our graduates will be

"BOTH ABLE AND WILLING TO WORK."

If I am right in this, I care little what particular work they undertake. They will choose their vocation wisely and follow it successfully. One of our great points is gained in intelligent choice. * * * * *

CENSUS OF THE MANUAL TRAINING SCHOOL.

Now, perhaps it will be more to the point if I give the result of an inquiry among the pupils of my highest class, the boys who have worked in all our shops as joiners, wood-turners, blacksmiths and machinists, and who are fair, practical draughtsmen, and who will finish their course in less than two months. They number twenty-nine, and they were asked to state frankly what work or occupation they wished to follow next year. Their answers were as follows:

To continue study in an advanced course	11
To enter a machine shop	6
To enter an architect's office	4
To work as machine draughtsmen	3
To be an engraver	1
To be a blacksmith	1
To be a bricklayer	1
To enter real estate business	1
To farm and raise stock	1
Total in the class	29

Now what these boys will really do, no one claims to know; circumstances will have as much to do with the matter as taste and fitness. I have given their appetites, and it appears that eleven of them are still hungry for study. I could carry this investigation into the lower (and larger) classes, but it is not necessary. I have answered the question as well as I could.

C. M. WOODWARD,
Director.

WASHINGTON UNIVERSITY.*

COMPREHENDS:

I. The Undergraduate Department—Including the College and the Polytechnic School, Washington Avenue and Seventeenth Street.
II. Henry Shaw School of Botany, 1724 Washington Avenue.
III. St. Louis School of Fine Arts, Lucas Place and Nineteenth Street.
IV. St. Louis Law School, 1417 Lucas Place.
V. St. Louis Medical College, 1818 Lucas Place.
VI. Missouri Dental College, 1818 Lucas Place.

* From the catalogue for 1891–1892.

The following schools are organized under the charter of the University :—

I. Smith Academy, Washington Avenue and Nineteenth Street.

II. Manual Training School, Washington Avenue and Eighteenth Street.

III. Mary Institute, Locust and Beaumont Streets.

Information in regard to any of the above departments may be obtained from

GEO. M. BARTLETT,
Sec'y, Washington University.

The following extracts from the paper read by Dr. Woodward before the American Society of Mechanical Engineers will serve to show the relation of the Manual Training School to the Polytechnic School of the Washington University, in which, besides being an end in itself as an independent school, it also serves as a preparatory school for the boys who propose to enter the Polytechnic School to be trained as engineers. One important phase of the Manual Training Schools is to prepare their pupils for the higher schools of science, just as classical academies and high schools fit their pupils for the classical colleges. It is in this relation that Dr. Woodward treats of the school in this paper and that Professor Thurston of Cornell, and the other gentlemen who participated in the discussion which followed, treated the topic.

On this point Dr. Woodward said:

"The Manual Training School stands in need of the Polytechnic to supplement its work, as truly as the Polytechnic stands in need of the Manual to properly prepare students for its ministrations. Purely manual work is elementary in character; it is only the close reasoning about such work that requires maturity, and only those who have tried our plan, can know how helpful it is to the polytechnic student to be familiar with the manipulations of practical mechanics.

All that was said a year ago by Prof. Alden, in regard to the wholesome intellectual effect of combining theory and practice, is cordially endorsed by the writer. Even on the intellectual side there is no waste of time, in either the earlier or the later stages of our training. The reasonableness of every step in the course is evident to every one who enters upon it.

In this paper Dr. Woodward gave not only the course of study of the Manual Training School but also the engineering courses of the Polytechnic School. Professor Thurston gave also the Post Graduate, Engineering Courses of Sibley College at Cornell. These are of course omitted, and only such extracts from the paper and such parts of the discussion as relate directly to the Manual Training School are here given.

The Training of a Dynamic Engineer in Washington University, St. Louis.*

By Calvin M. Woodward, St. Louis, Mo.

The complete course of training supplied by this university consists of three distinct stages, which will be briefly presented in succession.

It is proper, that an account of these stages should be prefaced with the statement, that, as yet, no students have passed through the third stage. It is but

* From Volume VII, Transactions (read at the Chicago meeting of the American Society of Mechanical Engineers), p. 42.

recently organized, and next year, will be the first in which all will be in simultaneous operation. We logically began at the bottom, and have now reached the topmost story. The first and second stages have been tested, and their value confirmed by successful experience. Of the value of the final stage, we have no question.

The primary course of instruction is given in the Manual Training School, occupying three years, from the age of fifteen to eighteen on the average. The second stage covers four years of undergraduate instruction in the Polytechnic School from eighteen to twenty-two, at the end of which, the successful student receives the non-professional degree of "Bachelor of Engineering." The final stage covers one year of what may be called graduate study and investigation, the completion of which entitles the student to the degree of "Dynamic Engineer."

The Manual Training School was established as a distinct and separate preparatory department in 1879.

Our Polytechnic School was organized sixteen years ago. At first, the departments of Civil and Mechanical Engineering, were combined in one. Three years ago, they were separated, and the broader and more appropriate name of Dynamic Engineering was adopted. The name is respectfully commended to the consideration of this Society. In England, and largely in this country, a mechanical engineer is *first* of all, a machinist; *secondly*, a draughtsman; and *thirdly*, he is more or less (generally rather *less*) familiar with mathematics and theoretical mechanics. A dynamic engineer should be thoroughly grounded in all—in the theory as well as in the practice of the great prime movers which serve to develop the *forces* of nature.

1. THE MANUAL TRAINING SCHOOL.

This school gives systematic instruction in mathematics, science, language and literature, drawing and shop-practice. All of these five subjects enter into the programme of every day of every boy, two hours of school time being devoted to the shop, and one hour to each of the other four subjects. The school year consists of about one hundred and ninety days net, the home study varies from two to three hours daily, being the greatest with the highest class. The course in mathematics, is not unlike that in the high schools and academies which prepare boys for college. Arithmetic, algebra, geometry, mensuration, and some plane trigonometry. In science or applied mathematics, comes a science primer, physical geography, botany, elementary physics (including the construction and use of simple apparatus, and the determination of laws inductively) chemistry, (with very little laboratory practice, though we hope gradually, to introduce more) physiology and book-keeping.

The literary work consists of history, rhetoric, Latin, French, and English classics. Those boys who do not propose to take a higher course in a college or polytechnic school, may omit Latin and French, giving the time to more history. English composition, and political economy.

DRAWING.

Penmanship and lettering come under the head of drawing, which is practical rather than artistic in its aim, in view of the principle that the artistic should always follow the practical. The former is intricate, requiring maturity and familiarity with elementary principles; the latter is simple, plain, and intelligible to every boy of fifteen years, and so far as known, it has never been shown before, what boys of fourteen and fifteen are capable of in the art of drawing. We begin with orthographic projections of simple objects, generally modifications of geometric forms, requiring three views consistently drawn. This is all free-hand work on blackboard, or pencil work on paper. This training enables the boys to make and read their shop-drawings from the very first. Their first instrumental work is on stretched

paper with ink, and consists in learning to draw straight and curved lines in ink, clear, firm, and true. Free-hand sketches of simple articles which have details of simple shape, such as speed lathes, center rests, face plates, etc., are next followed by instrumental drawings of the same to exact scale, accompanied by a sheet of figured details and sections,

The drawing of the second year is all on stretched paper, and largely instrumental or brush work. Representations of blocks, plain, truncated or intersecting, drawn in strict orthographics; flat tinting, isometrics, lettering, borders; a machine (from the object) with the details; architectural details and ornament.

The third year drawing begins with two sheets of geometrical exercises, a sheet of line shading with shades and shadows; a sheet of brush shading of cones, cylinders, spheres, toruses, etc. The final exercise is the drawing from the object by actual measurement of a large engine, machine, or structure. This is first sketched and measured, then drawn and shaded with a brush. This drawing is as finished as the boy can make it, and shows the result of the course. A tracing on cloth is taken of the outline work. Nowhere in this course, do we teach linear perspective or descriptive geometry. The very simple exercises in intersection, screws, developments, and shadows are regarded only as geometrical exercises.

Throughout the drawing course the character of the shop-work going on at the same time, and its accompanying working drawing, is kept steadily in view.

SHOP WORK.

The shop practice extends over a very wide field, but like the drawing, which runs parallel with it, it is all required of every boy in the school, no matter what his plans for the future may be. It occupies two hours a day for five days each week.

The three hundred and eighty hours of the first year are devoted to wood, at the bench and at the lathe. Joining, with wood-carving, gluing, inside and outside turning, forms of beauty and forms of strength, constitute the series. The year ends with the construction of an article, original or copied, which shall embody as many of the steps already learned as possible. Incidentally, the pupils keep up the stock of handles, mallets, clamps, trestles, and shelving in the establishment, though the great majority of exercises are of a purely abstract character.

The size of a shop division is limited to twenty-four boys, under the charge of a single teacher, and the daily lesson is uniform for the division. A working drawing of the piece or model required is first made and explained by the teacher of the division. Every boy copies the drawing in his special book, and henceforth, works from the drawing. The piece is then executed by the teacher in the presence of the class. Attention is called to the order in which the steps are taken, what tools are used, and how new processes are combined with old ones. The boys then execute the task, each for himself, with or without special direction or help from the teacher. Boys who work rapidly and well, put their spare time after finishing their exercises into "extras," which generally combine the steps already learned, in some article of use or beauty. The slowest boy generally hands in an unfinished piece. The results are criticised, compared, and graded on an absolute scale where one hundred per cent. means reasonable perfection.

The aim is, to master the range of every tool, and to cultivate the habit of analyzing complicated processes into simple elements. A high degree of skill is not aimed at, the chief immediate object being an intelligent mastery of every step and every tool.

By a similar method, forging is learned during the middle year. The elementary processes of the forge, are learned one at a time, with just enough practice to fix them indelibly on the mind and to secure a moderate degree of skill. We have found it extremely useful in giving exact knowledge of forms, and in teaching how

to strike and how to hold pieces under the hammer, to use bars of cold lead in a preliminary exercise. The time apparently lost on a lead exercise is more than made good by the material and time saved in the subsequent forgings of iron and steel. The necessity of keeping up the supply of forging tools, and of the construction of a set of lathe tools, cold chisel and steel dog gives all the variety necessary for a course of mere instruction. The size of a working division during the second year is reduced to twenty-two; hence the shop contains but twenty two forges, anvils, and sets of tools. A total of only two hundred and eighty five hours is given to the forging shop. The remaining ninety five hours of the second year are given to pattern-making, moulding, casting (with plaster or lead), brazing and soldering. In connection with soldering, comes practice in cutting sheet metal for special shapes, and spinning. This work is done in strict connection with their drawing of intersections, and the developments of surfaces.

The shop practice of the third year is in the Machine and Fitting Shop. The maximum size of a working division is here reduced to twenty, and yet it has been found impossible to adhere strictly to uniform lessons, for the reason, that it is practically out of the question to furnish twenty complete sets of machine tools. We have found our wants fairly met by twelve engine lathes, four speed lathes, two drills, two planers and twelve vises. As one man is always detailed to keep the tool shop, nineteen are to be kept at work at once. Nevertheless, a large degree of uniformity is secured by means of systematic class instruction on the different tools, and then systematic rotation in the exercises. In the use of the planers and drills, a boy is first learner and then teacher. The series of exercises which we use, are the results of large experience in devising such work as shall prove most instructive, and best serve to develop the full capacity of every hand and machine tool. The exercises occupy fully four fifths of the year, and include the use of every tool in the shop.

The last few weeks are devoted to construction. In some cases, new patterns are constructed, in others old patterns, made during the second year, are used, and from the castings, (made elsewhere) articles of some complexity and real utility, are constructed. During the present year, the senior class is engaged in the construction of three upright engines, several jack screws, an emery grinder, and several pieces of brass work. The abstract exercises, however, covered the shop work from the first of September to the middle of April. These engines and other articles are not made with any view to an income. Our purpose in their construction is to give the students themselves, an opportunity to see how fully their exercises have prepared them for such constructive work, and on the other hand, to teach them, that no matter how comprehensive their experience may be, a new article may involve new problems which can be solved only, by thoughtful study, and the exercise of good judgment.

As to our policy of not carrying on a commercial establishment; of taking no contracts; and of not setting out to manufacture for any market—reference will be made later on. It may be now said, that we have found our present system of uniform exercises: 1. More fruitful in general skill; 2. Better adapted for teaching method and predcision; 3. More economical as admitting of a larger number students simultaneously under one instructor.

Such, then, are the chief features of the Manual Training School. It was not established, nor is it conducted, as a school for the primary training of mechanical engineers alone. It is a school for general training. It is assumed, that pupils entering its junior class, are too young and undeveloped to decide the all-important question:—what occupation or career in life shall he select. By the end of a three year's course, however, the bent or natural aptitude of a boy is generally found, if he has one. If he combines a love for practical work with strong mathematical power, then he has the prerequisite of an engineer. Thus far, those who have

entered the Polytechnic School as students in the course of dynamic engineering, have had good reasons for their selection.

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In the interesting discussion which followed the reading of this paper the several topics suggested were fully considered and a variety of opinions expressed; showing that there was by no means an entire consensus of judgment. The conclusions reached by personal experience as apprentices and workmen, which were graphically stated gave fire and life to the arguments. The talk was so full of suggestion and throws such varied lights upon the whole subject at issue, that it has seemed desirable to give it here in full; so far as it relates to the value of the instruction given in this class of schools.

DISCUSSION.

Professor R. H. Thurston.—I have been reading Dr. Woodward's very interesting paper with attention, and am very much pleased with the systematic way in which the work is evidently done at the Washington University. I am pleased to see that a considerable amount of practice in free-hand drawing is there insisted on, and that it includes some final work in machine sketching. This training gives the boys the best possible exercise in the movements of hand and arm, correlated with the action of the eye. The use of the sketches so made in the succeding work, with drawing instruments, illustrates a principle which a carefully planned course may illustrate in a great many ways—that of combining the practice of the moment with the preparation of work for a later period in the course. It will be often found thus practicable, to "kill two birds with one stone," and I know of no more important factor in the successful operation of any extended system than this. The order and succession of exercises are admirable.

I am very similarly impressed with the systematic plan and working of the shop instruction. I particularly like the system of introducing each exercise with a lecture—if so unpretentious a talk as is necessary in this case may be so denominated—in which the nature of the exercise is explained, and the method of its accomplishment; the tools to be used are indicated; their form, method of use, special characteristics stated; the piece to made, being exhibited, the best way of using the tool is explained, and the execution of the work is illustrated by the instructor. I do not think it possible to attain the desired result promptly and satisfactorily with classes, and to secure rapid progress, in any other way nearly so well as by this method of reaching every student at once, and thus leaving a minimum of time to be expended by the instructor, or individuals who happen to be slow or inattentive. With boys who have the real spirit and knack of the mechanic in them—and no others should ever be allowed to attempt to enter the profession of engineering, in view of their inevitable failure—it is marvelous to see how rapidly they acquire the power of skillfully using tools. I find many a youngster who had never used a tool before in his life, other than his jack knife, after a few weeks doing such work as his instructor, not to say the average journeyman, may well admire. His muscles and his nervous system are in a stage of growth when they can be made to accept this systematic training of every fibre of both, and when they are, by nature, best prepared to acquire the habits and to gain the sleight that is characteristic of the naturally good mechanic. If a boy does not show that he has the essential proclivities in childhood, it may be usually assumed with safety, that he is not of the elect, and he is not likely to prove, in later years, a good mechanic or a great engineer. I do not mean to say, however, that I regard the working into its best possible shape of such material as this latter as useless or

objectionable. I believe that nineteen boys out of twenty do possess more or less of the mechanic's tastes and powers, and that the other one out of the twenty will be so benefited, and his usefulness to himself and the world, so increased by shop instruction, that he will do well to secure it. But, in the work of life, a man must do that for which he is best fitted, and he can not hope to succeed in competition with the world if he attempts to make a livelihood and to carry on a business for which he is not fitted. The turtle may be an admirable diver, but he can not hope to succeed in the race with the hare, if the hare attends to his business.

It is claimed for the system of general exercises, such as has been described, that it secures fruitful application of talent in the acquirement of general skill; that it is especially well adapted for conferring upon the student, habits of method and precision; and that it is peculiarly well adapted for instructing classes, in which the work must be done by the least possible number of instructors. I believe these claims to be all perfectly correct. Once that knowledge and skill are acquired, the student is ready to turn his attention to their application in the arts and trades of whatever department he may choose to enter. He will succeed in any trade or will progress towards success in any department of engineering, *provided* he have, in addition to the skill of the mechanic, the intellectual and moral character and force essential to advancement in any and every walk in life. Without the latter, all the training that all the trade schools and schools of engineering in the world could give him would be useless.

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The rest of Professor Thurston's remarks are here omitted, as they relate directly to the Polytechnic School of Washington University, the training of Engineers in Sibley College, Cornell University, and to a consideration of the change of name proposed by Professor Woodward, from "Mechanical" Engineer to "Dynamic" Engineer.

Mr. William Kent.—I have watched the progress of the Manual Training School at St. Louis, for many years, with considerable pleasure. I think the success of that school will eventually make a revolution in our whole educational system. Our public schools must some day, make the change which has been made at St. Louis. Professor Woodward knows that I took part in the discussion of his presentation of the subject at the meeting of the American Association at Philadelphia, in 1884, and that I approve all that he has said to-day, especially in regard to the school-shop. I then said, that to judge of the value of the work of a student by its salability, was utterly wrong.

* * * * * * *

A portion of Mr. Kent's remarks, as was the case, also, with those of the other gentlemen who discussed the paper, was given to a consideration of topics in Professor Woodward's paper not here quoted, and to the question of the substitution of the word "Dynamic," in place of "Mechanical," to indicate the engineer graduates of Polytechnic schools, as suggested by Professor Woodward.

Mr. J. T. Hawkins.—I think I can offer some little suggestion with reference to the Manual Training Schools, that may be of value. I might premise, by saying, that I had the honor in 1865, to organize the practical exercises in the Manual Training School at Annapolis, and was in charge of it for four years afterward. The part of the present system adopted in such schools in the shops, which in my opinion can be improved, is that they do not give enough lectures in the shops. I think that shop lectures may be so extended and systematized, as to save a vast amount of time, and give information in a way that can not be given in the method adopted

by the Professor, that is, where one instructor is put in charge of a large number of boys whom he has to instruct verbally. During my first year at Annapolis, I adopted that plan and found that it occupied the time of three or four, while in a great many instances, lectures and tabulated statements put upon a black-board in the shops, saved a large amount of time. Take for instance, the question of tempering. A lecture would be given on that subject, and the results given in tabulated form and put up in the shop, enabling the boys to see at a glance, what they needed to do, to produce a certain result on certain kinds of metals for certain purposes. The same applied to cutting tools and their uses, and many other shop methods. I merely say now, that whether there be any value in them or not, I have copies of lectures given at the above institution with diagrammatic matter, which I should be glad to furnish to the Society as a part of this discussion, if it is thought desirable.

Mr. F. W. Taylor.—I desire to take exception to one statement made by Professor Thurston in his paper. His opinion is, that one year of practice in a school shop will supplant seven years of practice in an actual machine shop. I think it would be more nearly the contrary. I think one year of actual service in a machine shop would, in certain respects, supplant twenty years of practice in a school shop. Probably, the great majority of those who go through a practical course of that sort, intend to become masters; that is, they would not intend to remain workmen, and it would seem to me, that in the course of the school shop, the boy misses, perhaps, the one thing which will be afterward, of the greatest use to him in his experience with men, that is, the knowledge of the character of the men with whom he is dealing. He learns thoroughly the feeling of one student toward another and of a student toward a professor, but he fails to appreciate properly, the feeling of apprentices toward their teachers, of workmen toward their foreman, and of foremen to their employees, which will enable him afterwards, to manage men successfully. I think, that no training whatever, in a manual school can give a man this experience, which is more valuable than any manual dexterity, which he can attain, and which, I think, he never can get, if he starts at the other end as foreman, and attempts to work down. He can only have it by passing through the mill himself; getting there at seven in the morning and leaving at six, and being knocked about to a certain extent as an apprentice in the shops.

Mr. Angus Sinclair.—No one belonging to this society can have a greater interest in the development of the manual school system of this country than I have; but, at the same time, I think that sentiment which has been showing itself through the society, of depreciating the apprentice system, and giving preference to the manual school system, is not calculated to be of benefit to the mechanical interests of America. It has been repeatedly said here, that the apprentice system is dead, and consequently, we must look to the manual school system for something to take its place. There is no member, I presume, more around the shops than I am. I am continually over the country from the one ocean to the other. I spend half of my time continually traveling, and I am always watching the men who are doing the mechanical work of the country. I find, that there is a growing class of mechanical men-boys who have not the name of apprentices, but nevertheless, they are learning the trade just the same as apprentices used to do. They are not held down for seven years under the close rules of the apprentice system, but they have opportunities of learning the trade, that perhaps, the old apprentice system did not supply. Now, I think that the duty of the Mechanical Engineers' Society, in regard to that class, is to give them the opportunities of learning the higher branches of mechanical engineering, supplying them with facilities for night schools, where they can learn the principles which they are so often deficient in. That is a system which is becoming very widespread in Europe. It has been receiving a very great deal of attention in Great Britain lately. There is not a city of any size in that

island, where machine shops are running, that apprentices cannot go nightly to school, where they have the very best opportunities for getting the higher parts of the mechanical training; and I consider, that in that respect, this country is falling very badly behind Great Britain, and it is to a great extent, because this society and similar societies hold, that manual schools and the technical school should do what eventually will have to be done by the apprentice system. The great mass of those who are learning the business, are in shops, under some name or other, and there is where the great mass of experience is obtained that enables men to carry on manual work. A boy may work in a technical school or in a manual school and attain the skill which enables him to do a piece of very fine work, but there, he will never collect that great mass of experience that enables him to control men doing similar work to the best advantage in a great shop or even in a small shop. If I mistake not, the leaders of this society, the men who have made their mark on the mechanical work of this country, have risen through the shop. They have gained their technical knowledge, through burning the midnight lamp under the very greatest disadvantages. If they would help those who are coming in their footsteps, to obtain the information which they acquired under such great disadvantages, more easily, they will be doing a great work for themselves, to the country and for the mechanical interests generally.

Mr. J. M. Dodge.—I came here by railroad from New York. I would have known more of the country if I had walked; but it is a question, whether that would have been any decided advantage. I served my time in a shop. My foreman hit me with a hammer one day, because I asked him how to temper a chisel. Afterwards, I got a little engineering chart. I followed its directions at home, took my chisel back to the shop and found out I knew how to do it. I believe if I had gone to the manual training-school and had that lecture about tempering given to me, I would have known more about it than my foreman did. I do not believe, in this age of the world's history, it is worth while to cling to an old institution, simply because it is old. It is not fair to say that the apprentice system made foremen, because the apprentice system, out of a thousand boys, only made one foreman. The fact of the matter is, that the personality of the boy has got a great deal to do with it. I went through the shop experience very thoroughly. I went on a strike and got hit with a brick. I followed the men right through, worked with them, fought with them, and did everything, and I was thoroughly put to blush by a young man from the Stevens Institute, after I had erected an engine on a large ship, by finding out that he knew a great deal more about it than I did. I had built the engine, as I thought, and the proudest thing I did was to find a mistake in the design, which I afterwards discovered, was because I didn't measure right. The fact is, that I had some training at Cornell University, and afterwards, I went through the shop thoroughly, and I must say, I wish I could go through a manual training school now. So far as managing men is concerned, my experience is, that a man who knows what he wants will get it done. A man said to me: "What will you do if there is a strike?" I said. "I don't know. What will you do if there is a strike?" He prided himself on being able to manage men. He had a strike afterwards, and he didn't manage the men any better than anybody else. He fell right in, and did the best that he could, when the time came. I am largely of opinion that with good material, a manual training school will instruct thoroughly and perfectly as far as it goes, and that a man of the right mind will gather up the deficiencies without any trouble.

Professor S. W. Robinson.—I think that this course which has been detailed at some length, is an admirable course for students in mechanical engineering. I might state a few points from my own experience, which may be of some interest in regard to this question. In the first place, with respect to the apprentice system, in my experience of four years of apprenticeship in a machine shop, I never

got so much shop philosophy as this—that in forming a piece of iron for a machine there are two operations—first, rough dressing it out; and second, finishing the piece; and further, that in rough dressing the piece out, the way to do it well is to do it quickly, as the main point; and in finishing the piece, the way to do that well is not to take the biggest chip you can possibly take, but to take such chips as will give the best results as to form and surface. This is the kind of philosophy that should be given in our school shops. If a man can go through a whole apprenticeship and not get as much philosophy as that, I think that five minutes under a teacher in learning this, is worth more than four years' apprenticeship for this point. When you apply it to all the points, you will see that there is need of both applications. I think the school shop is a necessary element for the highest success, and that the machine shop is also a necessary element for the highest success in life. Let a young man who comes out of school full of philosophy go out and learn the practical. * * *

Mr. Hosea Webster.—The fact, that the majority of the prominent members of this society are men who have started from the bottom, and, as expressed in homely phrase "pegged up;" the fact that a great many of them have a good deal of distrust of "college men," and the fact, that many college men after being out of college a few years, would find it a hard matter to pass their first calculus examination, lead to a good deal of perplexity in the mind of one who may happen to be called upon to advise a young man desiring to become a mechanical engineer, what course to pursue. It is unfortunate that there is this distrust of the college man among our leading manufacturers, but may not one cause of it be found in the fact that, having spent four years in college, a young man is granted his degree, if he has attained an average of, say, seventy-five per cent., in his examination, and so gets into a seventy-five per cent. habit, while the profession of engineering is, above all others, a hundred per cent. profession?

A seventy-five per cent. tracing wont make a head draughtsman. The discussions of the matter of technical education, which are now going on, are a good sign, and indicate that the time is not far distant when manufacturers will realize, that technical education is the best foundation for the profession of mechanical engineering. The English system of paid apprenticeship is meeting with good success. A young man, upon payment of a small sum annually, is admitted into the shops, put to work with the men, and has special attention paid and careful practical instruction given him in return for the money invested. This system is said to be turning out some excellent young engineers. The technical graduate has reached the point where he has learned how to learn, and draw logical and practical conclusions.

The proper combination of the theoretical with the practical, must result to the advantage of the producer, and it is hoped, that the discussions in this society will soon bring about the desired result.

Mr. W. F. Durfee.—I am aware that the time is getting very short, and I will promise to be as brief as is consistent with a clear presentation of certain points which I regard as deserving of especial consideration in connection with any scheme of study and practice intended to serve as the foundation of the education of the mechanical engineers of the future. When an engineer of experience undertakes to erect a structure or mechanism of any kind, the first thing he considers, is, the character of the soil upon which he is to lay those foundations, upon whose stability the integrity and usefulness of all his future work depends. In such a fundamental matter, there must be no mistake; a proper selection *must* be made or disaster is absolutely certain.

I am a firm believer in the great possibilities and far reaching value of the work of the leading technical schools of our land in laying the foundations upon which the practice and the fame of the engineering of the future is to rest; provided,

however, that their efforts are conscientiously expended upon a wise selection of mental material.

Notwithstanding the fact, that the leading schools of engineering have met with some measure of success, and that there are many members of that profession, to whom they point with pride as evidences thereof, I am, as the result of a somewhat prolonged experience, firmly of the opinion, that these schools will not conserve the best interests of the future; until they adopt some thoroughly effective system of selection, which shall, at an early stage of their studies, cull out from among those students who aspire ultimately, to become engineers, such as have not that intuitive practical sense of the eternal fitness of things and of the adaptation of means to ends, *born in them as an endowment of nature*, which is an essential qualification of every competent engineer.

* * * * * * *

Professor C. I. King.—It seems to me, that when an apprentice has served his time, and when a young man from college, having been through the technical school, has served his time, we will say, and both come out, we will imagine, on a level, and begin their work in the shop,—that the apprentice has practically arrived where he is ready to begin to learn something. He is where he feels a responsibility that he has never had before, and if you are going to make a foreman out of him, he must acquire all that implies, after his apprenticeship has been served. It is equally so with a college man, if he is going to make a superintendent or foreman. The only difference, it seems to me, is, that your college man has a basis to build upon, that is as broad a foundation as can be laid. The difference in the broadness of these foundations, depends on the men altogether. It seems to me, that, in that respect alone, the college man is a good way ahead, and I hold, that, with this system of manual training, every college man, if has any natural ability, when he steps into the shop, he is capable of earning a living there. He is able to earn as much and in a great many cases, more than the apprentices. In regard to the different systems of work in the colleges, I hold, that it is almost impracticable, so far as good results are concerned in the way of instruction, to mix instruction and business, and especially so, if there is a time limit for completing the work. The result in every case, will be found, as Professor Robinson says, that you are sacrificing instruction to the completion of work. That has been my experience for eight or nine years. * * *

Professor Woodward.—I have little to add in closing the debate. I desire to thank Mr. Hawkins for his excellent suggestion, while at the same time, I ought to say, that we make continual use of the lecture method. In fact, the class, or "Russian" method of tool instruction, necessarily involves lectures, black-boards, and general explanation. The economy of our method arises from giving an explanation, a diagram, directions, etc., to twenty-four boys at once. Then, again, when they proceed to the execution of their task, the teacher knows so well what each has to do, that a glance suffices to tell whether the student is doing as he ought or not. Meanwhile, it must be remembered, that our students are not men; they are boys from fourteen to eighteen years of age, and that they know nothing whatever of engineering.

Again, I think the gentlemen who have spoken, have dwelt too much upon a single phase of the training of an engineer—that of being a shop foreman or manager. Some of you seem to regard what I call the "Training of a Dynamic Engineer," as only a new kind of apprenticeship, the object of which is, to make a man a good machinist or a manager of machinists. To be an engineer, means vastly more than to be a skillful workman or a fine executive officer, or both combined. I grant, if you wish, that it does mean thus much, but it means a knowledge of theory too; a knowledge and ready command of both analytical and graphical methods of investigation; a knowledge of the best practice; of what has been done, and how done, in the engineering world. An engineer is a man whose familiarity

with different methods and theories is wide enough to entitle him to speak of his "*judgment.*" A man who knows but one way, has no *judgment* about ways. A man who has never "seen any use" for graphical statics, or the calculus, or thermodynamics, simply admits, that he has no command of such things, and that countless opportunities for their use pass him without his being in the least aware of the fact. A born frontiersman is apt to "have no use" for a thousand of our great conveniences about which he knows nothing. These remarks are in part, suggested by some side-discussions I have heard at this convention. Let me say, that no subject is put down in the course of study given as an appendix to my paper, which I do not consider essential to the training of a finished engineer.

I am glad to find that you all appear to agree with me in regard to the policy of our shop. As regards what we cannot and do not try to teach in our shop, I will quote a word from that very keen observer and successful man of business, William Mather, Esq., manufacturer, Manchester, England, late Royal Commissioner of Education to America, now Member of Parliament.

"There is no possibility of teaching in a school, that sort of knowledge which practical work, carried out on commercial principles within restrictions as to time of execution, etc., can alone make one familiar with."—*Technical Education in Russia*, p. XII.

Bear me witness, that the manual training school does not claim to teach a single trade, nor to give business experience. * * *

It is because of the important relation borne by this school to the Manual Training movement throughout the United States, that so much space has been given to the account of its history and progress, and that the statements concerning it by Professor Woodward, as well as those giving the judgment and opinions of others, have been so fully quoted.

An account of the School of Fine Arts of the University will be given in a later volume of this Report.

The following extracts from the Annual Report of the Manual Training School for 1886–'87,* give the conclusions by the Director in regard to the result of the experiment and the latest information then accessible of the school.

"THE RESULTS OF EXPERIENCE.

The School is now in its seventh year. From the start it has been well patronized, and vacant seats have been few.

The enrollment shows a steady increase.

* * * * * * *

THE RECORD OF THE GRADUATES.

Four classes have graduated from the school. Much interest has been expressed in their records as affording some clew to the influence of their training in the school. It has therefore been thought best to give a full list of the names and present occupations of the first three classes as fully as known. At the same time it should be borne in mind that the full influence of the school is to be found only by following the careers of all who have been for a longer or a shorter time under its

*"A Catalogue of the Teachers, Students, Course of Study, and Methods of Instruction in the Manual Training School of Washington University. 1886–'87. St. Louis: Nixon-Jones Printing Co. 1886. Pp. 47."

influence. Only about one-half of those who attend the school remain to graduate, and the influence of the training has been scarcely less marked upon those who have been in the school two years than upon the graduates. Moreover, all the graduates are still too young to afford material for very definite conclusions.

These first two classes had no opportunity while in school to study Latin; consequently when they have sought to enter Polytechnic schools or colleges requiring Latin before admission they have been somewhat embarrassed to obtain the necessary instruction in Latin. All the present classes have had opportunity to study Latin in the school.

The list of the names and present occupations of the graduates as given in the report is here omitted.—The total number of graduates is given as 142. The attendance on the school is as follows:

SUMMARY.

Graduate Students	2
Third-Year Class	63
Second-Year Class	73
First-Year Class	84
Total	222

"In submitting the above report of the condition, methods, aims, and results, of the school during its six and a half years, the Director is gratified by the thought that in spite of its many shortcomings the school has served to demonstrate the entire feasibility of incorporating the elements of intellectual and manual training in such a way that each is the gainer thereby; and that he has correctly read the public demand for an education which shall insure the most valuable mental discipline, at the same time that it gives knowledge and skill of great intrinsic worth.

All inquiries and applications should be addressed to

C. M. WOODWARD,
Director, Manual Training School. St. Louis.

DEC., 1886."

The following is the list of the Managing Committee and of the Instructors, as given in the Catalogue for 1886–'87.

MANUAL TRAINING SCHOOL.

[Established June 6, 1879.]

MANAGING COMMITTEE. (1886–1887.)

Edwin Harrison, Chairman	322 Pine street.
Henry W. Eliot	Turner Building, Eighth street.
Samuel Cupples	Second and Olive streets.
William Brown	1301 Lami street.
William L. Huse	409 Washington avenue.

C. M. WOODWARD, *Director.*

Office at the University.

OFFICERS AND TEACHERS, (1886–1887.)

William G. Eliot, Chancellor	2660 Washington avenue.
C. M. Woodward, Ph. D., Director	1761 Missouri avenue.
Charles F. White, B. S., Superintendent of Workshops	3414 Washington avenue.

George W. Krall, Assistant in Charge of Third-Year Class........................3037 Olive street.
W. H. Vaughn, A. M., Assistant in Charge of Second-Year Class........................2842 Gamble street.
E. R. Booth, A. B., Assistant in Charge of First-Year Class........................Kirkwood.
Charles E. Jones, Instructor in Forging...........2312 University street.
George B. Woodward, Instructor in Iron-work.....3030 Chestnut street.
Harry M. Newington, Arch., Teacher of Drawing..2648 Pine street.
B. S. Newland, A. M., Assistant Teacher of First-Year Class........................2634 Lucas avenue.
Charles C. Swafford, Assistant in Physics and Rhetoric........................1903 Belleglade avenue.
Oscar W. Raeder, Assistant in Drawing............2909 Salisbury street.
George B. Swafford, Instructor in Wood-work ....2520 Whittier street.
Jennie M. Henderson, Assistant in Third-Year Work........................1436 S. Tenth street.

The catalogue for 1891–1892,* the twelfth year of the school, shows continuous growth. At the risk of some repetition the following summaries setting forth this development and showing the pressure on the school for enlarged facilities are taken from this, the latest official statement of the school.

Historical Statement.

The ordinance establishing the Manual Training School was adopted by the Board of Directors of the University, June 6, 1879.

* * * * * * *

Progress of the School.

The lot was purchased and the building fronting on Eighteenth street was begun in August, 1879. In the November following, a Prospectus of the school was published.

On September 6, 1880, the school opened with a single class of about 50 pupils.

During the summer of 1882, the large addition fronting on Washington avenue was built and furnished; this nearly doubled the capacity of the school.

The following table gives the total enrollment for each year since its organization:—

	Total enrollment.		Total enrollment.
1880–1	67	1886–7	226
1881–2	107	1887–8	223
1882–3	176	1888–9	241
1883–4	201	1889–90	249
1884–5	218	1890–1	289
1885–6	233	1891–2, to Feb. 10, 1892	310

The manual features of the school, as shown by its regular class exercises in drawing and tool-work, have been exhibited in other cities as follows:—

At the Annual Meetings of the National Educational Association:—In Saratoga, New York, in 1882. In Saratoga, New York, in 1883. In Madison, Wisconsin, 1884. In San Francisco, California, in 1888. In St. Paul, Minn., in 1890.

*Catalogue of the Manual Training School, Washington University. Saint Louis. 1891–1892. Pp. 68.

Partial exhibits have also been made: at Springfield, Fitchburg and Worcester, Mass.; in New York City and Albany, N. Y.; at Columbus and Cincinnati, Ohio; at Louisville, Ky.; at De Funiack Springs, Fla.; at Kansas City, Mo.; at Sioux Falls, So. Dakota; at Altoona, Pa., and at Jefferson City, Mo.

A full selection was sent to the International Exposition in Paris, 1889, and the school was awarded a gold medal for the same.

PLAN FOR INCREASING THE CAPACITY OF THE SCHOOL.

In view of the increased demand for admission during the summer of 1890, the Managing Board decided to refurnish the First-year room, putting 125 new desks in the place of 100 old ones. All the seats were promptly taken and applicants were turned away.

Similarly in 1891, *every seat in every class* was taken when the school opened in September, and large numbers of students were refused admission from lack of room. Every nook and corner in the buildings is utilized to its utmost capacity. New students are received only as vacancies occur.

To meet this evident and pressing demand for increased accommodations, the Managing Board with the approval of the University Board of Directors, have proposed a plan for enlarging the plant of the school to a capacity of 500 students. The plan contemplates the erection of a new shop-building, four stories high, which shall contain eight large shops with auxiliary dressing rooms, offices, store rooms and engine rooms.

The lot upon which the school now stands is too small to conveniently admit of much extension, and it is therefore not possible to give a full description of what may be done. The Board of Managers will cordially welcome co-operation from any and every quarter.

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"SCHOOL BUILDING AND ACCOMMODATIONS.

A perspective view of the present school building is given as a frontispiece.

The shops are at present all in the portion fronting Eighteenth Street.

The same wing also contains one of the drawing rooms, and the chemical rooms.

The ordinary school rooms occupy the three floors of the west wing. The shop equipment is briefly described as follows :—

THE TWO WOOD-WORKING SHOPS.

Each wood-working shop is upwards of forty feet square, and has uniform accommodations for a class of twenty-five pupils.

Each pupil has one of the uniform sets of hand edge-tools for his exclusive use, kept in a locked drawer. For the care and safety of these tools he is held responsible.

The school has 50 speed-lathes* for wood-turning, 50 benches, 50 iron vises, 50 sets of common tools, 50 sets of wood-carving tools, and 150 individual sets of edge-tools in as many drawers.

Each shop has two grindstones which run continuously during shop hours.

THE MOLDING AND CASTING ROOM.

This shop contains 24 benches and sets of tools, flasks, etc., for molding. A small gas furnace is used for melting alloys and for heating the core oven. Separate benches and furnaces are provided for soldering.

In this shop is the band saw which is used for cutting lumber into sizes suited to class exercises.

*Two of these lathes are of iron made for the school by the class of 1888.

THE FORGING SHOP.

The first floor of the shop-wing is devoted to metal work, and comprises the machine shop and the forging shop. The forging shop is 40 feet square, and has its complete equipment of twenty-four forges, anvils, tubs, and sets of ordinary hand tools. The blast is supplied by a power blower, and a large exhaust fan * keeps the shop reasonably free from smoke and gas, even when all the forges are in use.

THE MACHINE SHOP

Is 40 x 50 feet. It possesses an equipment of sixteen engine screw-cutting lathes, six speed lathes,† two planers, two drills, a shaper of 15 inches stroke, a large and a small emery grinder, a gas-forge,‡ an anvil and tools, and a tool-room. Ten vises and benches afford opportunity for bench work. The shop is furnished for a class of twenty-four students at once.

The engine-room is below this shop. The engine is capable of about forty horse-power. It has a 12-inch cylinder and 12-inch stroke, and runs at the rate of 200 revolutions per minute. The steam-generating apparatus of the University consists of a battery of three large steel boilers, set and furnished in the most approved manner. These boilers furnish heat for the entire group of University buildings, as well as steam for the engine in the shop. The equipment of steam power furnishes to pupils of the Third-Year class the means of becoming familiar with machinery on a practical scale.

CHEMICAL LABORATORY.

A well furnished Chemical laboratory with excellent facilities for experimental study is provided, and each Second-Year student becomes acquainted by actual chemical work, with the real facts of Chemistry, and acquires the true spirit of investigation.

PHYSICAL LABORATORY.

A room on the second floor is fitted up for the practical study of physical laws and measurements. The laboratory contains a speed lathe for wood turning, an engine lathe for metal turning, and a large assortment of hand-tools for the construction of physical apparatus by the students themselves. The physics lecture room contains several hundred dollars' worth of apparatus, bought or home made.

DRAWING ROOMS.

Two drawing rooms are in continual use every day for six hours. Each has twenty-five drawing stands, cases for one hundred and fifty drawing boards, and large numbers of models, specimens, and machines for object and detail drawing."

Several pages follow showing the details of the shop work, illustrated by plates from Professor Woodward's excellent book entitled "The Manual Training School; Its Aims, Methods and Results," published by Messrs D. C. Heath & Co, Boston. In place of these pages, and of the pages given to the "theory of Manual Training" which follow, I have thought, as these topics have already been

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* This fan, a "Sturtevant" with a delivery of 18′ by 23″, was presented to the school by Mr. Sturtevant, the inventor.

† Two of these lathes were made for the school by the Class of 1887.

‡ The gas-forge is furnished with an air jet from a tank kept filled by an oscillating-cylinder air pump made by certain members of the Class of 1888.

treated in this history, that the brief paper recently read by Professor Woodward at the meeting of the National Education Association, in which he gives his conception of the ideal Manual Training Master, would serve to show what is to be demanded of the Teacher, and so, inferentially, what is required from the pupils, and will illustrate the distinctive character and purpose of these schools.

THE TEACHER OF TOOL WORK.

By C. M. Woodward, St. Louis, Mo.

The proper functions of the shop teacher are little understood. He is not a historical character. Literature is not full of him; his sayings and doings are not on record; he is the latest product of evolution. Doubtless many of you have pictured him, in imagination, as a brawny fellow, with immense brown hands, with deft ways, an unerring eye, a fund of anecdote, abounding in ungrammatical figures of speech, drawn from the bench, and cherishing undying admiration and reverence for the man he served under while learning his trade. You fancy him more fluent in directions than reasons; therefore, more ready to take one's tool and do one's exercise himself than to patiently explain and illustrate the method till his pupil can do it.

But you are in error. You are thinking of the experienced mechanic, not of the accomplished teacher. This new type of teacher is not a common article as yet. It is still a curiosity, and visitors to a school fortunate enough to have one spend most of their time watching him and his work. Let me give an account of him and present his picture.

This man has never served his time—that is, he has not spent from three to seven years earning his living while learning the mechanical processes and the business management of a single trade. His knowledge of applied mechanics differs from that of the ordinary workman as the mathematical training of a senior wrangler differs from the art of a lightning calculator. Under a variety of expert teachers he has mastered the principles and become familiar with many crafts; he has studied a wide range of tools and materials, and is equally at home at every bench.

But he is much more than a master mechanic; he is a draughtsman, almost an artist, ready to sketch an engine or a pump, to find the shade and shadow of a Greek vase, or to give a "chalk talk" illustrating Longfellow's "Bridge" before his class. Then he is somewhat of a scientist, and he sees how truly the principles of a lever and the inclined plane underlie all mechanical operations; he has experimented upon the effects of heat on meat, and has studied the dynamics of elastic fluids. He is able to classify the phenomena of the shop and can show how different the ideal problems of the text-book are from the real problems of industry.

Moreover; he is gifted with speech and has some knowledge of his vernacular. He never says, "I know, but I can't express it," for he can express it either in words, by drawings, or in the concrete—that is, provided the thought is clear. If the thought is not clear, he knows that there can be no clear expression. He is sufficiently a psychologist to know how to work out a clear thought when one is within his reach.

He has no reputation for superior workmanship; he has never invented a valve motion nor a motor, nor is he the author of a text-book on any subject; but he has a level head, a clear voice, a steady hand, a confident look, and a reassuring smile.

Yes, he is a rare man, and he has been rarely trained, but I will be satisfied with nothing less for my shop teacher.

So much for the man; now how does he teach and manage his class?

In the first place, he believes it is his chief function *to teach*. His pupils are not to be left to find out for themselves how the various tools are to be used, how they are to be kept in order, and how a certain model is to be produced. He would no more leave them to thus teach themselves than you would give pupils pen, ink, and paper and leave them to learn penmanship by themselves; or than I would give an ignorant sailor a sextant and leave him to find out how to determine a ship's latitude and longitude by constantly trying. Tools are not what they are through accident or caprice; they are the product of ages of thought and experience, and there are best ways of using them. There is teachable art in handling the chisel, the gauge, and the file as there is in using a table fork, a tennis racket, and a drawing pen.

Moreover, as he has a score or more pupils to teach, he teaches them as a class and not individually; this enables him to make his instruction much more systematic and full, and it leaves him time to observe whether his instructions are followed. The class lecture is, therefore, almost a daily feature in his shop. It may occupy thirty minutes or only ten, but while it lasts, it must absorb the attention of every pupil. He must have facilities for seating his class around his bench, anvil, or machine-tool; so that they may be quiet and attentive and have good opportunity to see as well as to hear. His room must be noiseless, and he must have at hand tools, materials, drawings, and blackboards. It is not a lecture properly so called, for as a rule he does not read to his class; he talks, explains, and illustrates. He suits the action to the word and the word to the action. This is an important point, for, like every other teacher in the school, he is a language teacher. When the need of a new word is clearly seen he gives it to his pupils, writes it before them, and henceforth it is a part of their vocabulary. He knows just where the class stands, how much and how little they know of the work in hand, and he discretely leads them on a step at a time, and a step they never need retrace. He teaches the theory of every tool, and how it is to be put in order and kept so; he shows just how it is to be used and when; he analyzes a complicated operation into a series of simple steps, and points out the logic of his arrangement; he warns of peculiar difficulties and dangers; he leads his pupils to see that drawings may represent not only the details of form, but order of construction. Gradually he helps his pupils to build up a love for system, precision, and plan.

When his class instruction is over—and he is careful not to confuse and mislead by telling too much—he never tells all he knows—the pupils go to their separate places and reduce to genuine practice what to them is still only theory. The work of the class is as uniform as that of a class in algebra engaged on the solution of the same problem, or in chemistry when the pupils are performing the same experiment. A glance is sufficient to enable our teacher to detect a wrong motion or a false step, and he supplements his general instructions by such individual directions and explanations as may be necessary. He thus economizes time and no pupil waits for him to come round. All have been taught, all have had opportunity for the same personal experience. If a pupil is inattentive or dull—and you may know that sometimes happens even in other studies—he patiently repeats what he has already said and done, or sends the dullard to a brighter pupil for direction and light; but he would no more take one's tools and do his work for him as the ordinary mechanic is generally too apt to do, having an eye more to the finished exercise than to the development of the child, than the teacher of English would write his pupil's composition, or the teacher of penmanship would fill out his pupil's copybook, or the teacher of drawing would finish his pupil's sketches. Success lies not in having certain things done, but in getting one's pupils to do them as well as they can.

When our teacher has examined and graded the pupil's work, he does not throw all the poor pieces into the waste box, but he shows a pupil the manifest defects of

his workmanship, carefully preserves the specimen, no matter how poor, and encourages the pupil to replace it by a better one, made during such spare time as he may secure by getting other work in before "time is up." This encourages and rewards care and attention to business. There is no waste time in his shop. The rapid workers, who have no need to repeat their exercises, are always furnished with "extras" (corollaries to the main proposition) which fill their time, tax their ingenuity, and fire their ambition.

The discipline of the shop is such as promotes industry and fidelity. The standard of behavior is not that of the recitation-room, it is rather like that of the chemical laboratory. Necessary communication is allowed, but all trifling and distractions are strictly prohibited.

While in the shop our teacher dresses as he expects his pupils to dress, appropriately. He sets no bad example; his language is correct and pure; his manners are those of a gentleman. The atmosphere of his shop is that of a science laboratory. His pupils soon become zealous and enthusiastic, there is no sense of drudgery, and no sordid motive impels to work. The pupils are as innocent of definite plans for utilizing the knowledge and skill they are acquiring (beyond the making of a toy, a present for a friend, or a convenience for his home) as they are in their arithmetic and history. The consciousness of growing power, both mental and manual, gives a satisfaction which throws a charm over every department of school work.

It is rather significant, especially in view of the fact that, after having been practiced for some years, similar drill was discarded by the Baltimore Manual Training School, that military drill has, during the past year, been introduced in this St. Louis school. All pupils in the third year of the course, unless especially excused, are required to devote two hours per week, "to systematic instruction and practice in military drill." This is in addition to the regular course of school and shop work.

The catalogue shows that the school is flourishing with a larger attendance than ever before.

LIST OF OFFICIALS.

MANAGING BOARD OF THE MANUAL TRAINING SCHOOL FOR 1891-1892.

Edwin Harrison, Chairman.......................520 Olive street.
Henry W. Eliot.................................Odd Fellows Building.
Samuel Cupples.................................3673 Pine street.
William L. Huse................................Gay Building.
Henry C. Haarstick.............................Main and Walnut sts.
E. C. Simmons..................................Ninth & Washington av.
C. M. Woodward, Director.......................Office at the University.

OFFICERS AND TEACHERS.

W. S. Chaplin, A. M., Chancellor.................2809 Washington av.
C. M. Woodward, Ph. D., Director.................1761 Missouri av.
George W. Krall, B. S., Assistant in Charge of Third Year Class, and Teacher of Geometry and Science.................3037 Olive st.
Charles H. Spooner, A. B., Assistant in Charge of Second-Year Class, and Teacher of Latin and Algebra.................2634 Park av.
Wm. R. Vickroy, Ph. B., Assistant in Charge of First-Year Class, and Teacher of Algebra and English.................2933 Dickson st.

George B. Woodward, Instructor in Iron-Work and Auditor of Shop Accounts........................1751 Preston pl.
Charles E. Jones, Instructor in Forging............2314 University st.
Oscar W. Raeder, Instructor in Drawing...........2227 Warren st.
George B. Swafford, Instructor in Wood-work.....4249*a* Evans av.
Marian E. Cox, Ph. B., Instructor in Chemistry and History....................................2612 Park av.
Wm. F. Barnes, (Class of 1885) Assistant in Drawing..1319 Elliot av.
Geo. Y. Bast, (Class of 1888) Instructor in Science..3918 Cook av.
George Arrowsmith, Instructor in Wood-work.....7024 Stanley av.
Janet C. Gloss, Ph. M., Instructor in Latin and Modern Languages.................................2950 Dickson st.
Clara Sessinghaus, Ph. B., Instructor in Mathematics and Rhetoric.............................2901 Rauschenbach av.

The Mechanical Handiwork Schools of the Spring Garden Institute, Philadelphia, Pennsylvania.

In the account of the Night Classes in Mechanical Handiwork of this Institution, given in Chapter II of Part III, the origin of this Day School, modelled after the two Manual Training Schools just described, has been stated.*

It was a logical development of the elementary classes; yet,—as now well established, with machine shops in the basement, and class rooms on the first floor of the spacious building of the Institute, and possessing a good plant of machinery, an excellent driving engine, and in charge of a thoroughly trained, scientific director,—it is a very different affair, and offers a very much more advanced curriculum of study and practice, than was afforded by the experimental night classes first held in the attic of the building. In adding, to the mere manipulative training common to these mechanical classes, the special instruction in steam engineering, which is given by the educated Naval Engineer in charge; these schools of the Institute illustrate the steps by which educational institutions, at first similar in character and purpose, develop differently;—and are, as the scientists say, 'differentiated.'

In this instance it is plain that the pupil who aspires to advance beyond mere elementary training in mechanics, finds here special opportunities for acquiring a theoretical and practical knowledge of steam engineering;—very desirable knowledge, in this era of steam motors in a great manufacturing centre.

In another school, similar in its elementary course, the development might as easily be towards Architecture, and the practical construction of buildings, or towards the making of complex machinery, or the practical manufacture of textiles, or in a knowledge of mining engineering;—the particular direction depending upon the immediate industries of the neighborhood,—or the specialty of the Instructor,—or, to use another modern technical expression,—the general or special 'environment' of the pupil or school.

*See Part III, pages 85 and 86, *et seq.*, of the present Report.

The beginning of this development of the mechanical classes is recorded in the 32nd Annual Report (1882–'83) of the Spring Garden Institute (north east corner Broad and Spring Garden Streets, Philadelphia).

The work rooms are thus described.

"In the basement three large apartments are fitted up with benches, a forge, machine tools driven by a gas engine, and all the appliances of first-class machine and pattern shops. In this department instruction is given in Mechanical Handiwork to classes meeting at night. The schools have a capacity of about 50 pupils per night. Each class meets two evenings per week, so that instruction can be given to about 150 individual pupils. This department, like the drawing-schools, is used to its full capacity."

These additional rooms and the consequent increase of facilities by the addition of an engine and suitable machinery, made possible the development of these night classes into the regularly organized institution, here described; the circumstances resulting in this important change are recited in the above Report as follows:

Early in the fall, President Arthur detailed Lieut. Robert Crawford, U. S. N., as superintendent of our Mechanical Handiwork schools, and that gentleman entered so heartily into the work of the Institute that the schools were greatly improved and the course of study and practice systematized. Excellent work was done by all the pupils, and there is every prospect that during the next term Lieut. Crawford will be able to so organize the classes and the course of study, as to make the school one of the most efficient in the country.

Mr. James S. Whitney generously offered to contribute $500.00 towards equipping a class in wood-work. This was accepted and a room fitted up for instruction in this branch of handiwork. The class, though organized late in the season, did very satisfactory work in pattern making. During the next term it is probable that the school will be enabled to turn out completed work from drawings made by the pupils, with every operation except that of casting done in the school-rooms by the pupils. A class in steam engineering was organized, to which lectures were given by Lieut. Crawford. It was well attended, and, with better accommodations next year, will doubtless become an important feature of the school-work.

One hundred and ninety-one pupils were admitted to this department of the Institute, distributed as follows:

Steam Engineering	16
Pattern Making	16
Vise and Lathe Work	159
	191

In the steam and mechanical engineering class the occupations were as follows:

Draughtsmen, 6; machinists, 5; and engineer, fireman, clerk, florist and shoe finisher, one each.

In the pattern making class the occupations were:

Students, 5; clerks, 5; printers, 2; and draughtsmen, pattern makers, nail makers and machinists, one each.

In the vise and lathe work departments, the occupations were:

Machinists, 60; students, 38; clerks, 14; engineers, 6; tool makers, 3; and brass finishers, fruit dealers, locksmiths, boiler makers, mill hands, draughtsmen, safe makers, 2 each; and mathematical instrument makers, chair makers, steam fitters, tinsmiths, shuttle makers, press hands, foremen, plumbers, blacksmiths, clock

makers, watch case makers, loom bosses, moulders, rubber stamp makers, architects, hardware dealers, brakemen, tin roofers, wood turners, rubber workers, spinners, farmers and iron cutters, one each.

The average age of the pupils was very much larger than in preceding years.

An exhibition of the works of pupils was given at the close of the term, and prizes, contributed by Tallman & McFadden, Heller & Brightly, Queen & Co., William Y. McAllister, and Gen. H. G. Sickel, were distributed to the most deserving pupils.

A Prospectus of the Schools of the Spring Garden Institute, for the season 1883–'84, was issued in a handsomely printed pamphlet of 24 pages.

Such portions as relate to the mechanical night classes, will be found in the preceding description of them; the following pages relate to the courses of the Day Mechanical Handiwork Schools.

The Technical Schools.

The object of Mechanical Handiwork Schools is the education of young men in mechanic arts. This class of education is no longer an experiment, but is an established feature of educational enterprise both in this country and Europe. The cities of London, and Manchester, England, have each their trade schools, and two of our own cities—Chicago and St. Louis—have theirs, under the name of Manual Training Schools.

All the cities of this country of large manufacturing interests are awakening to the very great importance of providing schools for the technical education of that class of their population who are engaged in industrial pursuits—not colleges of technology, which as a rule, hold the prize they offer beyond the reach of the mass of the people, but trades schools, such as these, for supplying training adjusted to the wants of those who are to be our mechanics, and the leading men of our shops and manufactories.

Owing partly to the very numerous sub-divisions of work in mechanical manufactories, the majority of those who enter them for the purpose of learning trades do not advance further than mere tool hands, or bench hands, and as such are not qualified to accept employment in other departments of the trade they set out to learn. It is to counteract this tendency and to supply the training necessary to produce complete mechanics, that the mechanical schools of this Institute have been established.

The demand for good mechanics increases yearly, and owing to their scarcity, our manufactures are frequently driven to the expedient of importing from Europe men competent to fill the leading positions in their shops. With a system of technical training for the youth of our country, such as is set forth in these pages, manufacturers would be relieved of this necessity, mechanical trades would advance, and a comparatively easy way to advancement be opened to young men of mechanical tastes and capabilities.

The afternoon session provides opportunity for instruction in mechanical drawing and shop work for those who are employed during the earlier hours of the day. In point of mechanical training this course is little inferior to that provided for the full-course pupils.

Remarks on the night classes in steam engineering and handiwork, will be found on pages 19, 20 and 21.

The course of mechanical instruction, with all the classes, is progressive: commencing with simple geometrical figures and ending with the finished model, machine, or pattern.

Competent teachers have been employed to instruct in the various branches set

forth in the curriculum of these schools. The shops are supplied with the best of hand and power tools, and the instructors are mechanics of wide experience and the highest skill.

DAY CLASSES.

Full Course.

Length of course, two terms of 9 months each; term commencing October 2nd and ending July 2nd. Five days' instruction per week, and one daily session from 9 A. M. to 2 P. M.

COURSE OF STUDY.

First Year.

Mechanical Handiwork—comprising a bench course in chipping and filing to line; production of true surface; laying off work and fitting-up; and a course in lathe, planer, and other power tool work; also one in carpentery, pattern-making, and elements of moulding.

Mechanical drawing, and elements of Machine Designing.

Algebra, as far as Simple Equations, and Arithmetic.

Elementary Mechanics.

Geometry and Mensuration.

Weekly Lectures on Workshop Appliances during first three months, and on Machine Construction during the remaining months.

Second Year Course.

Machine Designing, and Mechanical Drawing.

Applied Mechanics.

Steam Engineering, comprising designing and construction of Land and Marine Engines and Boilers; Thermo-Dynamics, and Economy of Fuels.

Geometry, Trigonometry, Algebra through Quadratics, Descriptive Geometry.

Elective Course in Mechanical Handiwork.

NUMBER OF HOURS' INSTRUCTION IN EACH BRANCH PER WEEK.

First Year.

Machine Work	10	hours.
Pattern-Making and Carpentry	7	"
Mechanical Drawing	5	"
Lectures and Recitations	3	"
Total	25	"

Second Year.

Machine Designing and Mech. Drawing	10	hours.
Applied Mechanics	1	"
Steam Engineering	4	"
Geometry, Trigonometry and Algebra	2	"
Descriptive Geometry	1	"
Free-hand Sketching	2	"
Mechanical Handiwork	5	"
Total	25	"

AFTERNOON CLASSES—SESSION FROM 2 TO 5 O'CLOCK.

Course of Instruction.

Metal Working—comprising a course in Bench and Power-Tool Work. The ordinary operations the pupil will perform in this branch are the following: Laying off work; chipping and filing to line; production of true surface; fitting up work; turning, planing, screw-cutting, boring and drilling.

Wood-Working: In this branch is comprised carpentry, wood-turning, pattern-making, and elements of moulding.

Lectures on Work-Shop Appliances.—These explain the principles underlying the various mechanical operations performed by the pupils, the correct use of tools and their construction.

NUMBER OF HOURS' INSTRUCTION IN EACH BRANCH.

Metal or Wood-Working	11	hours.
Mechanical Drawing	3	"
Lectures	1	"
Total	15	"

NIGHT CLASSES.

Special Course in Steam Engineering.

Instruction will be given by lectures, aided by models and diagrams.

A course of six lectures on Valve Gears, Valve Setting and Lap. Lectures on Monday evening of each week, from 8 to 9½ o'clock.

A course of ten lectures will be given on Designing, and Construction of Engines and Boilers, (Land and Marine) and Economy of Fuel. Lectures on Thursday evening of each week, from 8 to 9½ o'clock.

These lectures have been arranged with the special view of meeting the wants of Draughtsmen, Engineers, Machinists, and others interested in the care or building of Steam Machinery. They are practical in character, and furnish data which will be of daily use to the pupils.

A large working model of a Slide Valve, with its reversing and other gear, will be used to demonstrate Valve Setting and the effect of Lap.

EXPENSES.

Students will furnish their own text books where required by the curriculum; also drawing instruments and paper. Drawing boards and T squares are furnished by the school.

TUITION FEES FOR THE VARIOUS COURSES.

The School Year consists of Three Quarters. The fees are by the quarter and payable in advance. The rates are as follows:

For full course students, first year,	$15	per quarter.
" " " second year,	25	"
Afternoon students	9	"
Night students, Mech. Handiwork	5	"
For course of Six Lectures in Steam Engineering	3	"
For course of Ten Lectures in Steam Engineering	5	"

The tuition fees are so arranged that a student may discontinue his studies at the end of a quarter, should he find it necessary to do so, without pecuniary loss to himself or to the Institute.

APPLICATION FOR ADMISSION.

Applications for admission to any of the classes may be made to Lieut. Robert Crawford, U. S. N., in charge of the Technical Schools.

The Mechanical Handiwork Committee will attend from September 24th to September 29th, to receive applications for admission to the Mechanical Handiwork Classes.

TEACHING STAFF OF THE SCHOOLS. 1883–'84.

Mechanical Handiwork.

Lieut. Robert Crawford, U. S. N., Sup't. John Hall, Thomas Williams, George R. Allen, Thomas Henshaw, Thomas Chase.

All these Handiwork Schools are under the general direction of the following committee:

COMMITTEE ON MECHANICAL HANDIWORK.

John J. Weaver, Chairman, T. Broom Belfield, Chas. S. Heller, Wm. H. Crawford, Henry M. Worrall, V. E. Archambault, H. G. Sickel.

In October, 1883, these schools had an attendance of 84 pupils.

SPRING GARDEN INSTITUTE. 1883–'84.

Officers.—President, John Baird; Vice-President, Isaac C. Price; Treasurer, Wm. Hobart Brown; Secretary, Addison B. Burk.

In the 33rd Annual Report for the year 1883–'84,—the account of the second year of the experiment is given as follows:

"THE MECHANICAL SCHOOLS.

Under the superintendence of Lieut. Rob't Crawford, U. S. N., the classes in this department have been organized so as to show the best possible results with the facilities at our command.

The day classes started last fall with doubt in the minds of many, whether they could be made successful, but they have come up to the expectation of their friends, and are daily growing in favor with those desirous of fitting themselves for mechanical pursuits. Monthly reports, showing the average obtained by the pupils in the several studies, are prepared for the parents' inspection; the pupils all display much interest in the course of instruction, and produce specimens of their shop-work, which is creditable to the school as well as to themselves. Among them are eleven from the University of Pennsylvania and thirty-one Soldiers' Orphans from the Northern Home.

The subject of industrial education is each year receiving increased public attention; and outside of the direct influence which this Institute is exercising in that good cause, by the course of instruction it is offering, your committee takes pleasure in calling your attention to the official visits which these schools have received from representatives of other institutions, which are considering the question of adding manual training to their curriculum. In a former report, attention was directed to the visit from a committee from the Board of City Trusts, with a view to introducing mechanical handiwork in Girard College. The experiment was tried, and has evidently been successful, for this year separate buildings are being erected, in which instruction in this branch can be taught; thus, the future graduates of Girard College will be better equipped for the battle of life than those of the past.

During the term now closing, we have had official visits from the managers of

the Young Man's Institute, the West Philadelphia Institute and the House of Refuge, in this city, and unofficial visits, of which no record has been kept, from individual representatives of institutions outside of the city and State, who came seeking information touching this important subject of manual training.

The following statement gives the number of pupils in the several classes:

Day pupils, 95; extremes of age, from 13 to 42 years; average age, 17 years.

Occupations.—Students, 73; clerks, 6; machinists, 5; farmers, 2; carpenters, 2; stone cutters, 2; wire workers, 1; unknown, 4.

Steam engineering class, 28; extremes of age, from 17 to 44 years; average age, 21 years.

Occupations.—Machinists and apprentice machinists, 20; draughtsmen, 3; plumbers, 2; and screw maker, clerk and moulder, each one.

The work of the pupils was on exhibition for a week in April, 1884, with that of those attending the other Art and Mechanical Classes of the Institute, and on April 28th the prizes adjudged were awarded in the presence of a large and enthusiastic audience.

The prizes given for "Mechanical Handiwork" were contributed by the following gentlemen: "Messrs. Heller & Brightly, W. Mitchell McAlister, H. T. Patterson & Co.; Joseph G. Ditman, Gen. H. G. Sickle."

The report of the Judges was as follows:

"MECHANICAL HANDIWORK SCHOOLS.

PHILADELPHIA, *April* 21*st.* 1884.

To the Board of Managers of the Spring Garden Institute.

GENTLEMEN:—Your Committee to whom was assigned the duty of deciding the relative merits of the Mechanical Handiwork classes for the term just expired, has awarded the following prizes, viz:

METAL WORK.

1st Prize, Albert Way, fitting pyramid and block.
2nd " Edward Lancaster, Cube.
3rd " H. P Howgen, Tongue and Groove.
4th " W. Helmuth, Valve model disc.
5th " A. H. Wood, Work on cast iron blocks.
6th " C. Buckhaltz, Filing cast iron block.

WOOD WORK.

1st Prize, H. A. Hunt, Fitting, turning, etc.
2nd " Edw. Seibert, Fitting and general excellence.

MECHANICAL DRAWING.

1st Prize, H. T. Paiste, Original Design.
2nd " W. J. McCarroll, Locomotive.
3rd " Theo. A. Vandyke, Gearing and injector.

There are numerous pieces in this display which we examined, besides those to which prizes were awarded, that reflect much credit on both teachers and pupils.

Yours respectfully,

EDWARD LONGSTRETH.
JOSEPH ZENTMAYER."

It is suggestive of the interest felt in this experiment, as well as of the far reaching influence of such practical demonstrations at times when the public interest is really aroused; that the very first months of the school resulted in convincing the authorities of Girard College of the advisability and practicability of giving to their students like opportunities.

The Superintendent of the Mechanical Department reports the attendance of the Day pupils and of the Steam Engineering Night Class. for 1884–'85, as follows :

"MECHANICAL DEPARTMENT.

To the Committee on Mechanical Handiwork:

Statement of the number of pupils in the several classes of the mechanical department of the Institute, together with the usual information respecting age and occupation.

DAY CLASSES.

Full course pupils, daily session, 9 *A. M. to* 2.30 *P. M.*

Senior class, 5 members; Junior class, 15 members; Freshmen class, 29 members; Extremes of age, 14 to 26 years.

Afternoon classes, Daily session, 2 *to* 5 *p. m.*

Course in wood and metal work:

From University of Pennsylvania:—One class, 8 members; one class, 10 members. Extremes of age, 17 to 24 years.

From Soldiers' Orphans' Home—One class, 31 members. Extremes of age, 12 to 15 years.

From other schools, 3 pupils taking special course in joinery.

Total day attendance, 101.

ROBERT CRAWFORD, U. S. N.,
Superintendent."

The fees of the day classes have been raised so as to cover the bare cost of tuition. "The pupils paying charges ranging from $15.00 to $25.00 per quarter."

The report of the Board of Managers for this year, given in the account of the Institute which precedes the history of the drawing classes, recites their visit to Girard College, and to the House of Refuge, to inspect the Mechanical Schools, opened as a result of the success of the Institute Schools; they also state that a collection of pupils' work in the Art and Mechanical Departments was sent to the New Orleans "Cotton Exposition", and much commended by the press.

The succeeding report of the Board of Managers covered 15 months, ending June 30, 1886, on account of a change in the time of holding the Annual Meeting from April to July. The following paragraphs from the manager's report, recite the changes affecting the Mechanical Handiwork Schools.

"Very little change was made during the year in the organization of the schools, but early in the season efforts were made to provide the Mechanical Handiwork

Department with better quarters. It was at first proposed to rent rooms outside, but nothing suitable being offered, it was determined to provide for them in the building. With this end in view the Lecture Room was reduced one-half, the southern part being divided into two drawing class-rooms. The north rooms on the first floor were utilized as work-rooms—one for wood and the other for metal work, and a stairway constructed to the basement (heretofore the workshops), where the Mechanical Classes now have their lavatory and closets.

The Drawing School rooms on the second floor, together with the workshops, give ample accommodation for the Mechanical Department, and also enable the Managers to devote the whole of the third and fourth floors to the Free-Hand Department.

Lieutenant Crawford, having resigned as Superintendent of the Mechanical Department to accept a similar position in the City's Manual Training School, Mr. Arthur L. Church was elected to that position. Mr. Church served until the end of the term with Mr. W. H. Norris as his assistant, Mr. Norris succeeding as Superintendent when Mr. Church left the Institute to accept a responsible position in the Baldwin Locomotive Works."

The announcement is also made that the fees of the Mechanical Handiwork Classes have been "made uniform at $90 per annum." A considerable increase from those of the first year.

"MECHANICAL DEPARTMENT.

PHILADELPHIA, *April 5th*, 1886.

To the Committee on Mechanical Handiwork:

GENTLEMEN :—I present the following statement of the present condition of the Mechanical Schools:

Day Classes—9 a. m. to 2 p. m.

Senior Class, 10 members; Junior Class, 10 members; Freshman Class, 20 members; Special Class, 7 members. Extremes of age, 12 to 27.

Afternoon Classes—2.30 p. m. to 5.00 p. m.

From University of Pennsylvania—Post Senior Class, 7 members; Senior Class, 10 members; Junior Class, 17 members. Extremes of age, 17 to 25.

From other Schools (2.30 p. m. to 5.00 p. m.)—One class, 8 members. Extremes of age, 12 to 17.

From Soldiers' Orphans' Institute (2.30 p. m. to 5.00 p. m.)—One class, 26 members. Extremes of age, 12 to 16.

Total attendance in Day Classes 115."

"Several pupils in the Night Classes have taken only the first half-term—three leaving, with six in the Day Classes, to accept positions with manufacturing establishments. During the year also a number have been admitted for short terms of special work.

ARTHUR L. CHURCH, *Supt.*"

The exhibitions and awards of prizes were held in April 1885, and in May 1886.

In the extracts from the 36th Annual Report* of the Board of

*"Thirty-Sixth Annual Report of the Board of Managers of the Spring Garden Institute, northeast corner of Broad and Spring Garden Sts., Philadelphia. For the year ending June 30, 1887. Spangler & Davis, Printers, 529 Commerce st., Philadelphia. 1887. Pp. 32."

Managers for the year ending June 30th, 1887, which are given at the close of the general account of the Spring Garden Institute, which precedes the account of the Drawing Classes, given in this volume, the references to this Mechanical Department show no changes from the preceding year, but continued prosperity with the better rooms and increased accommodations;—the exhibit of the work of the scholars is also referred to, and the notice in the Public Ledger is given.

The Director makes the following report of the Day Classes:

MECHANICAL SCHOOLS.

PHILADELPHIA, *June 13th*, 1887.

To the Committee on Mechanical Handiwork:

GENTLEMEN:—I beg to present the following report of the condition of the Mechanical Schools at the close of the school year:

Morning Classes—Hours: 9 a. m. to 2 p. m.

Senior Class	me	4	
Junior Class		14	
Freshman Class	"	4	
Special Classes	"	9	
			31

Ages, from 14 to 23.

Afternoon Classes—Hours: 2 p. m. to 5 p. m.

From University of Pennsylvania:			
Post Senior Class	members,	5	
Senior Class	"	15	
Junior Class	"	8	
			28
From other Schools	"		7
From Soldiers' Orphans' Institute:			
One Class	"		40
Total in Day Classes			106

The numbers of students in the various classes as given above, are of those who remained until the end of the year. There were several who left during the term from various causes—three from the Senior Class to aceept positions with manufacturing firms.

W. H. NORRIS,
Superintendent Mechanical Department.

These schools are under the direction of the following Committee for the year 1887–'88—

"COMMITTEE ON MECHANICAL HANDIWORK.

William H. Crawford, *Chairman;* Henry M. Worrall, John S. Stevens, Thomas Wood, Joseph J. De Kinder, Edward Longstreth, Arthur L. Church."

THE CHICAGO MANUAL TRAINING SCHOOL.

This school, the latest established institution of its class, is modelled closely after the St. Louis School.

It is another instance of the methods by which in the United States,

educational, as well as other needs, are met by the voluntary co-operation and organization of citizens; the movement, of which this school is the result, having originated with the members of a club, composed of many of the leading business men of Chicago; as is recited in the following brief statement kindly furnished for this Report by H. H. Belfield, Esq.,—

"The Chicago Commercial Club is an organization of prominent merchants and manufacturers, limited to sixty in number. At the regular monthly meeting of the Club, held at the Palmer House, March 25, 1882, the question of 'The Need of a School for Industrial Training in Chicago' was discussed; and, as a result, the Club resolved to undertake the inauguration of such an enterprise. It was determined to raise the sum of $100,000 for the purpose and, in a few moments, $57,000 were pledged to this object.

In a very few days the whole amount desired, $100,000, was subscribed, and has been paid.

Steps were taken to secure a charter under the statutes of the State of Illinois providing for 'corporations not for pecuniary profit.' The charter was obtained April 11, 1883, and formally adopted by the Club, May 5, 1883.

This charter vests the control of the school in 'The Chicago Manual Training School Association,' composed of contributors to its funds, whether members of the Commercial Club or not. The management is placed in the hands of a Board of nine trustees, elected for nine years, one third retiring every three years.

The execution of the project was not delayed, however, till the receipt of the charter. December 30, 1882, the Club elected the following:

BOARD OF TRUSTEES.

"E. W. Blatchford, President; R. T. Crane, Vice President; Marshall Field, Treasurer; William A. Fuller, Secretary; John Crerar, John W. Doane, N. K. Fairbank, Edson Keith, George M. Pullman."

March 28, 1883, after careful examination and thought, a lot, 50 ft., on Michigan Boulevard by 171 ft., on Twelfth St., was purchased for $25,000. May 5, 1883, Mr. S. S. Beman, the architect of the town of Pullman, Illinois, was elected architect; and June 9, 1883, Mr. Henry H. Belfield, at that time Principal of the Chicago North Division High School, was made Director of the new school.

The corner stone of the building was laid September 24, 1883, in the presence of the Club and of invited guests, including the Lord Chief Justice of England."

On this occasion Mr. E. W. Blatchford, President of the Board of Trustees, delivered an appropriate address, from which the following extracts, giving a succinct history of the Club and of the proposed schools, are taken.

"*Members of the Commercial Club,*

LADIES AND GENTLEMEN: The occasion which calls us together this afternoon, marks an epoch in the history of our Club, and may I not say an epoch also in the history of our city?

It is now six years since the organization of the Chicago Commercial Club. At the monthly re-unions during eight months of each year have subjects of practical value been presented and discussed—vital questions relating to the social, civil, and political well-being of our city and State. These discussions have stimulated thought, investigation, action. Beneficent results have thereby been accomplished, not traceable perhaps by the general public to their source, but none the less real and potent, because silently achieved. The building whose corner-stone we lay to

day, as I have said, marks an epoch in our history—an exception to our ordinary mode of action, in that it presents *material proof* of our work.

The same may be said of its relation to the history of our city, coming forward as it does a new and warmly welcomed auxiliary, to join the grand educational forces in the conflict being waged between good and evil.

By a thorough and deeply interesting evening's discussion some two years since, the attention of the Club was directed to the general subject of education, during which was developed the need of something beside the course at present pursued in our graded and high schools. Especially was this felt to be a pressing want in the great centres of commercial and manufacturing enterprise. Later, an evening was given exclusively to the subject of Industrial Education, and the work already accomplished in our own and foreign countries was presented; and on that evening it was heartily resolved to contribute from our membership $100,000 as a fund to establish in our city a Manual Training School. It is fitting that at this time our indebtedness should be acknowledged for valuable ideas and practical suggestions to the St. Louis Manual Training School and its able Director, C. M. Woodward. Opportunity was afforded for personal observation of this school, by a visit of our Club to the St. Louis Commercial Club, in October last. Our own course will closely follow the curriculum prescribed by the St. Louis school.

The distinctive work of the Chicago Manual Training School is clearly stated in the Articles of Incorporation.

Since the organization of the Board of Trustees the interests of the school have quite constantly occupied their attention. The lot on which the building is being erected was purchased, and after careful observation and consideration, building plans were adopted after drawings made by our architect, Mr. S. S. Beman. We were favored in securing, as Director of the school, Mr. Henry H. Belfield, long and well known as principal of the North Division High School. Under his direction we anticipate the opening of the school early in January next.

May I add a word regarding the future support of this school? The fund subscribed by the Commercial Club will, it is believed, prove sufficient for the purchase of the lot, the erection of this building, its furnishing of machinery and tools, and its current expenses for three years. Looking forward, however, to the growth of the school, we would invite the co-operation of other citizens in the work before us. Provision for the increase of the membership of the Manual Training School Association by contribution to our funds is incorporated in our By-Laws. Already, unsolicited, has a generous donation been made towards the equipment of our building.

The field occupied by our school is not altogether new or untried. Differing from the Polytechnic Schools in this country and abroad, it does not teach specific trades, but prepares its pupils to enter upon the honorable field of mechanical pursuits rapidly enlarging in this and other countries. In closing, let me add: Our aspiration for this school for industrial education, for the character of its pupils, for its accomplished work, for its every influence was well expressed in the words of a Christian philosopher over eighteen hundred years ago, in a letter addressed to one of the commercial cities of the Orient: "Whatsoever things are true, whatsoever things are honest, whatsoever things are just, whatsoever things are pure, whatsoever things are lovely, whatsoever things are of good report."

"*Officers of the Commercial Club of Chicago, for* 1883–'84.—John M. Clark, President; Geo. M. Pullman, Vice President; A. F. Seeberger, Treasurer; Geo. C. Clarke, Secretary; B. P. Moulton, John J. Janes, Executive Committee."

THE SCHOOL.

February 4th, 1884, the building was so far completed as to permit the informal opening of the school: the formal opening is delayed till the completion of the building.

Two examinations had been held for admission, and out of 130 applicants, 72 boys were selected. The number was limited to 72 as only one room had been equipped with the necessary appliances for shop work. When finished and fully equipped, the building will accommodate between two hundred and three hundred, with rooms for recitation, drawing, laboratory, wood-work, smithy, bench and machine work in iron, etc."

The following is taken from the printed circular issued under date of November 21, 1883.

" *The object of the School* is clearly stated in the articles of Incorporation, as follows : " Instruction and practice in the use of tools, with such instruction as may be deemed necessary in mathematics, drawing, and the English branches of a high school course. The tool instruction as at present contemplated shall include carpentry, wood turning, pattern making, iron chipping and filing, forge work, brazing, and soldering, the use of machine shop tools, and such other instruction of a similar character as may be deemed advisable to add to the foregoing from time to time, it being the intention to divide the working hours of the students, as nearly as possible, equally between manual and mental exercises."

The Chicago Manual Training School.

Differs from the High School in omitting from its required studies foreign and ancient languages, in giving prominence to mechanical drawing, and particularly in affording scientific instruction and actual practice in the care and use of tools.

COURSE OF STUDY.

The following course of study is proposed, subject to whatever changes experience may dictate:

First Year.

Arithmetic, Algebra, English Language, History, Physiology, Physical Geography, Free-hand and Mechanical Drawing.

Shopwork.—Carpentry, Wood Carving, Wood Turning, Pattern Making, Proper Care and Use of Tools.

Second Year.

Algebra, Plane Geometry, Physics, Mechanics, History, Literature, Geometrical and Mechanical Drawing.

Shopwork.—Forging, Welding, Tempering, Soldering, Brazing.

Third Year.

Geometry, Plane Trigonometry, Book-keeping, Literature, Political Economy, Civil Government, Mechanics, Chemistry, Machine and Architectural Drawing, Machine Shop Work, such as Fitting, Turning, Drilling, Planing, etc., Study of Machinery, including the Management and Care of Steam Engine and Boilers.

Latin may be taken instead of English Language, Literature and History.

Throughout the course, one hour per day, or more, will be given to drawing, and not less than two hours per day to shopwork. The remainder of the school day will be devoted to study and recitation. Before graduating, each pupil will be required to construct a machine from drawings and patterns made by himself. A diploma will be given on graduation.

ADMISSION.

Candidates for admission to the first year must be at least fourteen years of age, and must present sufficient evidence of good moral character. They must pass a satisfactory examination in reading, spelling, writing, geography, English composition, and the fundamental operations of arithmetic as applied to integers, common and decimal fractions, and denominate numbers. Ability to use the English language correctly is especially desired.

EXPENSES.

The school year will be divided into two terms of twenty weeks each. Hereafter, the school year will begin the first Monday in September. Tuition is payable by the term, in advance.

First Year, per term	$30.00
Second Year "	40.00
Third Year "	50.00

Pupils furnish their own books, drawing instruments and material, aprons, overalls and pocket tools. Shop tools are provided by the School.

Teachers.—Henry H. Belfield, A. M., Ph. D., Director; Benjamin Hyde, B. S.; Charles E. Pickard, A. B.; Albert L. Trecker."

Though the course of study and practice for the first year was avowedly tentative it seems to have been satisfactory, as the circular for the ensuing year issued December 15th, 1884, makes no change of importance. The terms "Junior," "Middle," and "Senior" are used instead of "First," "Second," and "Third year" to distinguish the classes, and "Moulding, Casting, Chipping, and Filing," take the place of "Soldering and Brazing" in the practice of the Middle (second) year, otherwise the course is the same. In regard to the purpose of the school it is further announced that "It is the intention that the scholarship shall be fully equal to that of the best high schools." * * * "Boys who have completed a grammar school course or its equivalent are preferred."—"The next examination will be held June 30th, 1885, at 9 o'clock a. m. at the school building, corner Michigan Avenue and Twelfth Street."—The announcement is made that the discipline of the school will be maintained; "no pupil will be tolerated who is an impediment to the progress, or an injury to the morals of his classmates." * * *

"The Director assists non resident pupils in obtaining good homes.

"School hours are from 9 a. m. to 3.30 p. m. with an intermission of 30 minutes at 1 o'clock."

Under date of July 13th, 1886, the Director of the School has kindly furnished the following brief summary of its history during the past two years.

The second school year opened Monday, September 7th, 1884, with 66 pupils in the middle classes, 77 in the Junior, and a special class of 4: the corps of teachers having been enlarged to 6. In January, 1885, an addition to the corps was made in the person of Frank M. Bennett, Assistant Engineer U. S. Navy, who was detailed for duty in the school by the Secretary of the Navy.

The third annual catalogue shows the following summary of pupils:

Senior Class	28
Middle Class	46
Junior Class	77
Special Class	4
	155

The total number of pupils for the year was 157, 2 Juniors having been admitted after the publication of the catalogue.

Of the 72 boys who entered the school at its opening, February 4, 1884, 27 graduated June 24, 1886. On the previous day an exhibit of the pupils' work was given, a section of each class being at work in the shops. The exhibit was largely attended, and surprise expressed, by those best qualified to judge, at the excellent character of the work.

The Junior Class exhibited, among many other articles, exercises in mortising, tenoning, and dovetailing, panels, picture frames, umbrella stands, cases of drawers, tables, office desk with revolving top, twelve carpenters' benches for equipment of wood-rooms, glands, vases, balls, and other lathe work.

The Middle Class exhibited molding and casting of nuts, glads, valves, sheave pulleys, spur and bevel wheels, etc. Exercises in drawing, upsetting, bending, and tempering: open eyes, gate-hooks, hasps, staples, nails, bolts; square and hexagon headed bolt blanks, blacksmiths' tongs, cold chisels, screw-drivers, claw and ball-pene hammers of steel, etc., etc.

The Senior Class exhibit, contained exercises in chipping, filing, planing, and turning: three six horse power steam engines; four smaller engines, five dynamos; die stock, with set of taps and dies; brass Armstrong gun, 18 inches long, mounted bolts, screws, nuts, hammers, etc.

Two of the steam engines and two of the dynamos, were in operation during the exhibit. Three of the steam engines, all of the dynamos, and many smaller articles were made by the boys from their own designs and patterns.

The drawings numbered 5954, including free hand, geometrical, orthographic projection, line shading, shadows, machines and school building from measurement, architectural perspective.

The following statement of the mechanical facilities of the school—the "plant," is from the third annual catalogue (1885–6).

"The equipment of the mechanical department of the school is mainly as follows:

Wood-Rooms.—27 Cabinet-makers' Benches; 24 Speed Lathes; 1 Circular Saw; 1 Scroll Saw; 1 Boring-machine; 1 Planer; 1 Grindstone; 1 Shoot-plane; Bench, Lathe and General Tools for 72 boys.

Foundry.—2 Furnaces; Crucibles, Troughs, Flasks, Trowels, Rammers, Sieves, and other apparatus for 66 boys.

Forge-Room.—24 Forges; 23 Anvils; 1 Emery Wheel; 1 Shears; 3 Vises; 1 Blower; 2 Exhaust Fans; Tongs, Sledges, Hammers, Fullers, Flatters, Swages, etc., etc., for 66 boys.

Machine Shop.—7 Engine Lathes, 12 inch swing, 6 feet bed; 1 Engine Lathe, 16 inch swing, 8 foot bed; 2 Speed Lathes; 1 Planer, 6 foot bed; 1 Shaper; 1 Drill; 1 Grindstone; 15 Benches; 15 Vises; Lathe and Vise Tools, such as Chucks, Boring-bars, Taps, Dies, Hammers, Chisels, Files, etc., sufficient for 32 boys.

Power is supplied by a Corliss engine of 52 horse power and by two steel boilers.

The Chemical Laboratory for pupils' use is furnished with Tables, Drawers, Sinks, and accessories for 12 boys at one time. The Physical Apparatus consists of an Air Pump, Electrical Machine, Battery, Ruhmkoff Coil, Electrical Engine, Geissler and Crookes Tubes, etc., etc.

The Drawing Room contains 48 Tables, and is supplied with Models and Casts.

The School possesses a complete set of Boch-Steger Physiological Models, Physiological Charts, Maps, and Reference Books.

The *Blatchford Literary Society* has a small but choice library."

The Teachers for the year 1885–6 were as follows:

Henry H. Belfield, PH.D., Director; William R. Wickes, A. M., Junior Class; F. E. L. Beal., B. S., Middle Class; Frank M. Bennett, U. S. Navy, Senior Class; Earl B. Ferson, A. M., Mass.,* Drawing; Albert L. Tucker, B. S., Wood-work; Elroy A. Dillon, B. S., Foundry and Forge.

Board of Trustees.—E. W. Blatchford, President; R. T. Crane, Vice President; Marshall Field, Treasurer; William A. Fuller, Secretary; John Crerar, N. K. Fairbank, John W. Doane, Edson Keith, George M. Pullman.

The eighth annual catalogue, for 1890–'91, contains the announcement that the equipment of the school shops "has been steadily increased" and that "in 1890 the building was considerably enlarged." Turning to the statement in detail of the equipment of the Mechanical department of the school, it appears that the cabinet-makers' benches have been increased from 27 in 1886, to 48, and that general tools are now provided for 160 boys instead of for only 72, as in 1886.

In the Foundry, 90 boys can now be taught in place of 66. In the Forge Room 90 boys can be taught. In the Machine Shop 60 boys can now be accommodated where in 1886, only 32 could find room.

The "Drawing" Rooms can now accommodate 325 boys.

Summary of attendance for the year 1890–'91.

Senior Class	52
Middle Class	90
Junior Class	161
Total	303

The following estimate of the work of the school, as shown in the exhibition of scholars, work made during the year 1888–'89, is appended to the catalogue for 1890–'91.

"Extract from the report of the Committee on Annual Exhibit of drawings at The Chicago Manual Training School; published as Educational Leaflet No. 42, October 9, 1889, by the College for the Training of Teachers, New York City:

We, the undersigned committee, having carefully examined the Annual Exhibit of Free-hand and Mechanical Drawing exhibited at the school on June 17, 1889, take pleasure in making the following report:

*Art Master, Massachusetts State Normal Art School.

Your committee is agreed that the drawings show a high order of excellence both as to care, neatness and delicate handiwork, and also as to the conception of original problems, and the working out of these and all others with much perseverance, involving necessarily much hard mental work, owing to the difficulty of the problems and the youth of the pupils. These conditions are especially noticeable in the mechanical problems, some of them showing, in a very marked degree, clearness and boldness of execution, and comprehension of mathematical and mechanical principles.

The successful training of the mind in this direction, and of the eye and hand to produce free-hand sketches and mechanical drawings, such as those of the third year, is more noticeable from the amount of work necessary to bring the pupils, in so short a time, to this degree of excellence; for at their starting point, in the first year, they had practically no knowledge of the simplest kind of drawing, or of geometry, or of mechanical forms and movements.

Not only do the strictly "Mechanical Drawings" show conscientious work and clear understanding of the problems in plane geometry, projections, shades and shadows, and drawing machinery from measurement, but the free-hand sketches of mechanical objects forming part of the regular school work and most, if not all, of the home work, also show that this part of a skilled mechanic's training is not neglected. It is often considered that a knowledge of perspective and free-hand drawing is too artistic, and not sufficiently practical for a course of this kind; whereas, in fact, it is of great importance to boys who are quite as likely to become inventors and designers of machines as to be employed only in working out details from the designs of other men, or in any wood-working or metal-working trade. Even to the average draftsman who is not a designer, a knowledge of perspective and skill in free-hand sketching are invaluable in making drawings from a machine already built.

Your committee is especially pleased to notice the attention given to free-hand drawing, believing as it does, that the ability of the workman to use his pencil freely in the expression of his thought, is an important factor in an industrial development. The mechanic who, perceiving how an improvement may be made in this or that portion of machinery, or who, conceiving an original thought, is unable to explain the same by a sketch, is sadly deficient and can not compete with the workman educated not only to independent thinking, but in the free expression of the same. It is most important that the coming American mechanic shall be not simply the slave of his craft, but shall transcend it and shall be its master. This achievement is only possible when the education of the workman reaches out and beyond a reproduction of the works of others, even into the realm of invention, and constructive design.

* * * * * * *

In conclusion we take pleasure in commending not only the work of the pupils in following the course of instruction used, but the course of instruction itself as tending to give them at an early age, and even without their recognizing its importance, knowledge and skill which will be of the greatest importance to them in any future work of civil, mechanical, mining or electrical engineering or indeed in almost any work of manufacture or construction. (Signed)

JOSEPHINE CARSON LOCKE,
THOS. W. FRY,
SPENCER S. BEMAN,
Committee.

NOTE.—Miss Locke was for years Supervisor of Drawing in the St. Louis Public Schools. Mr. Fry is a mechanical engineer, graduate of the Mass. Inst. of Technology. Mr. Beman is a well-known architect.

THE WORK OF THE SCHOOL.

The special feature of the school, in which it differs from the ordinary high school, is its Manual Training. Notwithstanding the prominence given to this part of its course, experience shows that its mathematical and scientific work need not be inferior to that of the best high schools.

Education, not manufacture, is the idea underlying the manual training. Consequently, the material products of the shops consist chiefly of exercises designed to develop skill in the use of tools. The educational value of construction is also recognized, and the course embraces a number of finished articles.

Some idea of the pupils' work in the drawing and mechanical departments may be obtained from the following partial list of the annual exhibit of June 17, 1890.

JUNIOR CLASS.

In Drawing:—Freehand and Mechanical Drawing of Models, Tools, etc.; Problems in Plane Geometry; Line Shading; Principles of Projection, etc.; 9938 drawings.

In Woodwork:—2,000 Accepted Exercises in the various joints used in carpentry; 24 Tool Stands, 18 Flasks for Foundry.

1,400 Accepted Exercises in Wood Turning, such as Horizontal and Vertical Straight Cuts, Bevel, Concave and Convex Curves, Beads, etc., Tool Handles, Ornamental Hardwood Turnings, Vases, Gavels, Dumb-bells, Indian Clubs, Rosettes, turned Mirror Frames, etc.

450 Accepted Patterns of Hexagonal Wrenches, Journals, Hand-wheels, Pulleys, Grates, Quarter-turn and Half-turn Pipes, with Core Boxes, etc. Complete Patterns for the Speed Lathes made by the Senior Class. Complete Patterns of Adjustable Drawing Stand. Patterns for Friction Wheels of Atwood Machines. Patterns of Surface Plates, etc.

In Cabinet Making:—9 Hardwood Tables for Physical Laboratory, 2 Atwood Machines, 90 Picture and Mirror Frames, oak ; 3 Fancy Tables, 7 Cases of Bookshelves, 4 Wall Cabinets, 1 Easel, 1 Hat-rack, 3 Drawing Boards, 2 Turned and Carved Mirror Frames, 10 Cases for Artists' Materials, Jewels, etc.; 1 set of Drawing Models, 8 pieces ; 140 T squares, 280 Triangles for Drawing.

MIDDLE CLASS.

In Drawing:—Practice in Brush Shading; Orthographic Projection; Projection of Shadows; Isometric Projection; Perspective; Intersection of Solids; Line Shading; Machines from measurement, etc., etc.; 2774 drawings and sketches.

In Forging:—4800 Exercises and Finished Pieces in Forging Iron and Steel, including Drawing and Upsetting, Twisting, Bending, Punching, Welding, Tempering, the making of Hooks, Staples, Nails, Rings, Angle-irons, Brackets, Braces, Eye-Bolts, Bolts and Nuts, Chains with Hooks, Swivels and rings, etc.; including, also, 150 pairs Blacksmiths' Tongs, 34 Forgings for Jack-screws, 300 Lathe Tools, diamond-point, half diamond-point, etc.; 450 Tools, such as Center-punches, Chisels, Flatters, etc.; 37 "Projects," including 13 Cross-pene Hammers, 2 Ball-pene Hammers, 1 Axe, 1 small Anvil, 4 Piano Lamp Stands, 7 "five-o'clock-tea" Stands, 1 pair Pole Climbers, 3 Anchors, 1 set Lathe Tools.

In Foundry Work—Moulding and Casting in Lead, Zinc and Brass several hundred Washers, Nuts, Hangers, Oil Cups, Pulleys, Jack-screws, Valves, Wheels, Bushings, etc.

SENIOR CLASS.

In Drawing:—Machines from Measurement (Locomotive, Marine and Stationary Engines, Steam Fire Engines, etc.), Architectural Plans, Elevations and Perspectives, etc.; 918 drawings and sketches.

In Machine Shop Work:—400 Exercises in Chipping, Filing, Scraping, and Fitting; 100 Exercises in Planing, 200 Exercises in Turning, Boring, Screw-cutting and Polishing; 12 Speed Lathes, 30 Jack-screws, 3 pairs V Blocks, 3 pairs Parallel Blocks, 2 Angle Plates, 5 Nut Mandrels, 2 Boring Bars and Cutters, 3 Square-thread Taps, 2 Taper Reamers, 2 sets Brass Friction Wheels for Atwood Machines, 8 Double-thread Screws and Nuts for Wood Clamps, 1 Saw Arbor, Counter Shaft for Circular Saw, etc.

The finished "Projects" included 1 Dynamo, 3 Surface Gauges, 1 Machinists' Hammer, 1 Vertical Marine Engine, 4½x5 inches; 1 Brass Card Receiver, 1 Center Gauge, 1 Vertical Engine, 4x4½ inches; 2 Brass Tables, 2 pairs Calipers.

The tuition fees in all the classes have been increased ten dollars a term above the prices given in the Catalogue of 1883.

Provision is made for a certain number of free pupils and parents of such pupils as are desirous of securing the benefits of study in the school but who are not able to meet the cost, are invited to consult with the Director.

List of Instructors for the year 1890–1891.

TEACHERS IN ORDER OF DEPARTMENTS.

Henry H. Belfield, A. M., PH. D., 3738 Washington Avenue, Director; William R. Wickes, A. M., 238 Willis Street, Oak Park, English Literature; Harlow W. Eaton, PH. D., 5807 Madison Avenue, Physics and History; Charles E. Boynton, A. B., 5 Thirty-first Street, Chemistry and Physiology; Wythe M. Parks, Passed Ass't Engr. U. S. N., 362 Forty-fourth Street, Mechanics, Design and Construction of Engines; Sylvanus E. Lambert, A. B., 552 Chestnut Street, Algebra; Honta Smalley, A. B., 281 La Salle Avenue, Latin; Clem F. Kimball, B. M. E., 3933 Prairie Avenue, Geomtry and Drawing; Earl B. Ferson, A. M., Mass., 395 Fifty-eighth Street, Drawing; Fred'k Newton Williams, 329 Michigan Avenue, Drawing; G. Willis Ritchey, 5926 Dickey Street, Woodwork; Geo. A. Ross, 3933 Prairie Avenue, Woodwork; J. W. Raymond, Jr., 3558 Cottage Grove Avenue, Foundry and Forge; Thomas J. Gray, 437 West Madison Street, Machine Shop.

BOARD OF TRUSTEES.

CHAPTER III.

TULANE UNIVERSITY OF LOUISIANA, NEW ORLEANS, LA.

Brief statement of the origin of the University—Letter from Paul Tulane, to Hon. Randall Lee Gibson, U. S. Senator from Louisiana and his associates—Details of management of the new University wisely left to the discretion of the Trustees—Precedent made by the Founder of Smith College, Massachusetts, followed in this feature—Col. William Preston Johnston, called to the Presidency of the new University—The Professional Schools of the former State University are united with Tulane.—Comprehensive character of Tulane University—Why the account of the University occurs in this chapter—The equipment for the study of electrical engineering under direction of Professor Brown Ayres—Extracts from catalogue of 1891-'92—Historical statement—Plan of Education—University Department of Philosophy and Sciencc—Tulane College—Four separate courses of study—"Classical"—"Literary"—"Scientific"—"Engineering"—Drawing under Professor Woodward—Mechanical work under Professor Ordway—H. Sophie Newcomb Memorial College—Three separate courses of study—"Classical"—"Scientific"—"Modern Languages"—Special students—Art in college courses in each year—Special Normal Art—Elective Art work—The Libraries—Museums—Art Museum—Professor William Woodward, Art Director—Linton-Surget Hall an Art Museum—University Extension—Lists of names of the Faculty of the two colleges—Tulane High School—Organization and courses of study—Manual Training—Drawing—List of Faculty, 1892-'93—The Free Drawing school—Saturday classes for Women—Evening class for Men—The Mechanical course—The Free Hand course.

TULANE UNIVERSITY, NEW ORLEANS, LOUISIANA.

INSTRUCTION IN MANUAL TRAINING AND IN DRAWING IN THE PREPARATORY HIGH SCHOOLS AND IN THE COLLEGES OF THE UNIVERSITY. EVENING FREE DRAWING CLASSES.

A brief reference was made, in a preceding volume of this Report, to the founding and development of this successful University,* which has already won well merited distinction among the Institutions of Higher Learning in the Southern States, and indeed throughout the country.

This new University had its origin in the munificent bequest of the late Paul Tulane, a native of New Jersey, but for many years a resident of New Orleans. Mr. Tulane, living at the time in Princeton, New Jersey, confided to the Hon. Randall Lee Gibson, U. S.

* See Part II of this Report, pages CVIII-CXII.

Senator from Louisiana, his purpose to devise a large estate for the establishment of an Educational Institution in the City of New Orleans, and requested the Senator to undertake the proposed trust, giving him full discretion as to the kind of Institution to be established. Senator Gibson, after associating with himself several of the leading citizens of the State as joint trustees, undertook the arduous though honorable task; and Mr. Tulane had the happiness, during the few last years of his life, of beholding the successful initiation of the proposed institution.

THE LETTER CREATING THE TRUST.

The letter of Mr. Tulane, conferring his property in New Orleans upon the Board of Trustees, begins as follows:

"PRINCETON, *May* 2, 1882.

To Messrs. Randall L. Gibson, Chas. E. Fenner, James McConnell, T. G. Richardson, M. D., Edward White, E. H. Farrar, P. N. Strong, B. M. Palmer, D. D., Hugh Miller Thompson, D. D., Chas. A. Whitney, Saml. H. Kennedy, Walter Stauffer, Cartwright Eustis, Henry Ginder, John T. Hardie, R. M. Walmsley, and Wm. O. Rogers:

GENTLEMEN:—A resident of New Orleans for many years of my active life, having formed many friendships and associations dear to me, and deeply sympathizing with its people in whatever misfortunes or disasters may have befallen them, as well as being sincerely desirous of contributing to their moral and intellectual welfare, I do hereby express to you my intention to donate to you by an act of donation *inter vivos*, all the real estate I own and am possessed of in the said city of New Orleans, State of Louisiana, for the promotion and encouragement of intellectual, moral and industrial education among the white young persons in the city of New Orleans, State of Louisana, and for the advancement of learning and letters, the arts and sciences therein, my intention being that the benefits shall be applied and expended in the city of New Orleans.

By the term education, I mean to foster such a course of intellectual development as shall be useful and of solid worth, and not be merely ornamental or superficial. I mean you should adopt the course which, as wise and good men, would commend itself to you as being conducive to immediate practical benefit, rather than theoretical possible advantage. I wish you to establish or foster institutions of a higher grade of learning where the young persons to be benefited shall, upon due examination, be found competent and qualified for admission, both by age and previous training, to receive the benefits of a more advanced degree of educational culture.

Intellectual advancement should be unfettered by sectarianism, but the profound reverence I entertain for the Holy Scriptures leads me to express here the hope, that the educational development intended by this gift, should never antagonize, but be in harmony with the great fundamental principles of Christian truth contained in them."

Suggestions as to securing exemption from taxation for the real estate thus devoted to the promotion of education, and stipulations that none of this property shall be sold, or mortgaged, or, in any way, incumbered for a period of fifty years, follow. He also suggests that his "friend, General Randall Lee Gibson, shall be the chairman or President of the Board, and that Judge Charles E. Fenner, and James McConnell, may be vice presidents or vice chair-

men." The Board is to be self continuing; vacancies in the body being filled by election. If, at the end of fifty years, the Board desire to relinquish this trust, they are authorized then to distribute the property in such manner, to institutions in the city of New Orleans, as to best promote the educational purposes of the Trust.

* * * "With devout gratitude to our Heavenly Father for enabling us to form these plans and invoking his divine blessing upon you and your counsels, and upon the good work proposed among the present and future generations of our beloved Crescent City.

I remain, with great respect, your friend and humble servant,

PAUL TULANE."

AN ADMIRABLE PROVISION.

This letter, which resembles in its benevolent purposes and scope those written by Peter Cooper, Ezra Cornell, and Charles Pratt, when creating the several institutions founded by them, is very brief; leaving, as it does, the general plan and all its details to the judgment of the Trustees. After the statement of his purpose in creating the trust, as just quoted, the letter deals only with plans for preserving the property intact, and places its management and final disposition wholly in the hands of the Trustees; who are thus empowered to meet new demands as they may arise and to adapt their institution to the exigencies of the future. This feature, which was the notable peculiarity of the will of Miss Sophia Smith, in founding Smith College, at Northampton, Massachusetts, is in marked contrast with the old English foundations, where the obsolete customs of by-gone centuries, imposed on all successors, become hindrances in their development and usefulness. It is peculiarly desirable that educational foundations should be free to meet as they arise, the ever changing conditions of an advancing civilization.

It is to be hoped that the wise precedents thus set by Miss Smith, and Mr. Tulane, may be generally followed by those leaving legacies to our Colleges and Universities; since such gifts, however generously intended by the givers, are often, owing to onerous conditions imposed, burdens rather than blessings.

THE CHOICE OF A PRESIDENT FOR THE NEW UNIVERSITY.

Col. William Preston Johnston, (eldest son of the late General Albert Sidney Johnston,) formerly for some years a Professor in Washington and Lee University, Virginia, but at that time the President of the Louisiana State University, was called in January 1883, to the Presidency of the new University.

The calling of this thoroughly equipped, liberal-minded scholar, author, and teacher, to the direction of the new institution, was, in itself, an augury of success. A graduate of Yale, having had experience as a Professor for some years in a classical college of the old

regime, and having been President of one of the modern practical State Colleges of Agriculture, in Louisiana itself, President Johnston was well fitted to direct the shaping of the new institution. Familiar with the old methods and well abreast of the new movements in education, he was ready to adapt his instrumentalities to the needs of the community.

UNION EFFECTED WITH THE STATE UNIVERSITY.

The wisdom which, shortly after his appointment, effected the union of the professional schools of Law and Medicine of the University of Louisiana,—each having had a long and honorable history,—with the new foundation; including all under the title and headship of the "Tulane University of Louisiana," was another piece of good fortune; while the generous endowment which soon followed, by other liberal givers, of a Womans' College to be a part of the University, rounded out and fitly completed the scheme.

PRESIDENT JOHNSTON OUTLINES THE NEW UNIVERSITY.

Under date of June 1883, President Johnston addressed a letter to the Trustees, outlining the needs, province and methods of such an institution as, in his judgment, was, in view of the surrounding circumstances which were considered at length, then most desirable. This letter fills some sixty printed pages and is a most admirable statement both of the educational needs of the community and of the best methods of supplying them. Defining the province of a college, and a university, and clearly discriminating between their several duties, he makes a strong plea for Higher Education, and shows how essential it is that opportunities for obtaining such an education be provided; but, on the other hand, he shows the need of providing, also, facilities for giving direct practical training to such as cannot avail themselves of the higher courses. The institution therein portrayed included opportunities for the training of all classes of the community, just as, in fact, "Tulane" now does. This letter is well worthy the consideration of all who are called on to decide similar questions.

COMPREHENSIVE CHARACTER OF TULANE.

This new University, arising in the last decade, and blending in its catholicity the professional schools of the past with the novel forms of education which have been called forth by the imperative needs of modern civilization, furnishes a most interesting object lesson; linking, as it does, by its varied activities, the simplest elementary industrial training and the most advanced post graduate educational methods and instrumentalities.

It has evening schools like those of the Maryland Institute, and

Cooper Union; a Manual Training School like the Manual Training Schools of St. Louis, Boston, Philadelphia and Chicago; instruction in engineering equal to the engineering courses of the higher Schools of Science, of which "Sheffield, Yale," and "The Massachusetts Institute of Technology," may be taken as types; while in art instruction it claims to equal both the Art Training given in the Normal Art Schools, and that of the Art Drawing classes of the several High Art Schools and Academies; in addition to these modern innovations there are offered in the same Institution, courses of study in accordance with the strictly classical training of the old classical colleges, as well as those of the higher post graduate schools of the Medical and Legal Professions; while the inclusion of a high class woman's college further exemplifies the modernity of "Tulane;" so that this composite "University," stands forth as a comprehensive typical American Educational Institution of the last quarter of the Nineteenth Century.

That such an University, rivalling in its variety of schools and courses of training, its purposes and equipment, such famous modern Universities of the North, as "The University of Michigan," at Ann Arbor, and "Cornell," at Ithaca, should have been founded in the far-away Southern City of New Orleans, is both a pledge that the "New South" is to be kept fully abreast with the modern educational movements in Europe and America, and is a worthy memorial of the liberal Founder, whose gifts made possible its creation. It stands, also, in evidence of the practical professional skill of President Johnston, and his energetic Faculty; and of the far-reaching views and enlightened intelligence of Senator Gibson, and his colleagues.

RANDALL LEE GIBSON.

Alas! between the time of sending the above in manuscript to the printer and the return of the "proof" this noble hearted man, who had been chosen by Mr. Tulane to carry out his benevolent purposes, had met the Shadowy Form—

"That keeps the keys of all the creeds."

This true gentleman, faithful friend, brave soldier, wise, far-seeing statesman, sincere patriot, whose whole influence, as Member of Congress and as Senator, was exerted to promote the interests of our common country; and who, at the same time, while seeking to develop the material and intellectual resources of his own State of Louisiana, has linked his name forever with the national efforts for the improvement of the Mississippi River, and with the founding and development of the Tulane University of Louisiana, has passed from among men; leaving a record and a memory which cannot fail

to inspire, in all who knew him, a noble ambition to emulate hi virtues.*

The life of Senator Gibson, equally with that of the late Charle C. Perkins, of Boston, strikingly illustrates the inestimable valu that may result to a community from the civic devotion of a singl individual public spirited citizen. The ruling purpose of Senato Gibson, for the few last years of his life, was to promote the fulles and best development of Tulane University. So long as this Insti tution endures and the name of its founder is remembered, that o Randall Lee Gibson cannot be forgotten. They build for earthly immortality who inscribe their names as founders of our great Insti tutions of Learning.

WHY THE ACCOUNT OF TULANE IS GIVEN IN THE PRESENT VOLUME

As the Free Evening Drawing Classes, and the Manual Training Instruction given in this University, are of like character with the schools and classes whose history is given in this volume, while its manual training school is modelled after those recorded in the previous chapter, this account of Tulane University is here given.

Strictly classified, only these two features of the University would here find place; but, in this Report, some brief, general historical notice of the Institution, of which the department, or school, which happens first to be described is a part, has usually been given in connection with such department. In this particular instance this seems especially desirable for the purpose of showing how these forms of elementary training, which, in most other schools of their class, are only seen as segregated from any general scheme of education, are here brought into relation and unison with those studies and schools which are commonly recognized as pertaining only to Higher Education, and are shown to be a part of the common whole, having their legitimate place in the complete plan.

We have already seen in the pages of the preceding chapter how the Manual Training School founded by the Massachusetts Institute of Technology, and at first made so marked a feature, has gradually fallen into place as simply an elementary adjunct to the higher courses of Technical Education offered by the Institute; Tulane, in like manner, illustrates this wise correlation of Educational Forces. It is, because, in this new University the claim of "Drawing," both as a practical, Technical, and Artistic study, has been so fully recognized; and that the true value and relations of Manual Training to education, both in its elementary, general and special appli-

* The Hon. Randall Lee Gibson, U. S. Senator from Louisiana, and President of the Board of Administrators of Tulane University of Louisiana, died at Hot Springs, Arkansas, December 15th, 1892, and was buried at Lexington, Kentucky, by the side of his deceased wife, and among his kindred, December 19th, 1892.

cations are inculcated, that this University finds mention in this Report.

The details of instruction common to manual training schools have been so fully stated in the several accounts of the Public School Manual Training Schools of the country given in the preceding volume of this Report, (Part II.) as well as in the account of the Pioneer Schools of this class, whose history is given in the previous chapter; that only a general statement of the equipment of the Manual Training School attached to "Tulane" will be here given.

A High School is attached to the University for fitting pupils for entrance to Tulane College,—the Academical Department of the University,*—and a similar preparatory school fits girls for entrance to the H. Sophie Newcomb Memorial College.

Drawing and Manual Training are both included among the required studies in the boys High School, and are required studies throughout the "scientific" and "engineering" courses in the academical college. Two courses, the "Classical" and the "Scientific" are provided in the High School, and four distinct courses, known respectively as The "Classical," "Literary," "Scientific," and "Engineering," are given in the college. In the girls preparatory school, "Industrial Drawing" is taught; "Art Drawing," is a required study throughout the Woman's College course. There is, also, in the woman's college, a Normal course of "Art Instruction."

Besides these varied opportunities for the regular students in its schools and colleges, Tulane furnishes, also, by means of the free evening drawing school which it sustains, a practical instance of University extension; reaching out, as it does, to offer opportunities freely to all classes of the community.

The following extracts from the latest catalogue† give a general view of the University as a whole, with its varied activities; as well as of the special facilities for instruction in Drawing and Manual Training, both in the preparatory and undergraduate departments.

As already stated, the general account of the Institutions, some special departments of which come within the province of this Report, has been given in connection with that school or department first mentioned. It is in accordance with these precedents, that a somewhat extended notice of this University here follows the chapter

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*While these pages are in the hands of the Printer, information is received from President Johnston concerning the proposed reorganization of the University, substantially in accordance with expressed desire of Senator Gibson, the late President of the Board of Administration. The High School is to be discontinued and the post graduate department of the University to be developed. The Report recommending these changes was adopted January 9th, 1893, and will be given in full at the end of this account of the University. See pages 103–105.

†Tulane University of Louisiana. Catalogue, 1891–'92. University, College, High School, H. Sophie Newcomb Memorial College for Women, and Law and Medical Departments. Announcement for 1892–'93. New Orleans. 1892. Pp. 132.

describing the pioneer Manual Training Schools; the two first of which, it will be observed, were, in like manner, founded in connection with Educational Institutions of the highest class; viz: The St. Louis School attached to the Washington University, and the Boston School opened by the Massachusetts Institute of Technology.

Accounts of the Engineering Courses; the Art Courses in the Woman's College, the Art Museum, and the Evening Free Drawing Classes of Tulane would, however, be fitly given elsewhere in this Report in connection with others of their class, but are given here partly because it is desirable to show in one view how comprehensive in its courses, and how well provided by means of its laboratories, apparatus, libraries and museums to satisfy modern educational demands, is this new Institution of the South; and, partly, because in the issuing of a work of this class, comprised in several volumes and necessarily extending over a series of years in its preparation and publication, it has always to be borne in mind that unforeseen and insuperable obstacles to its completion may arise. It has, therefore, seemed doubly desirable that the fact that an institution so fully equipped for the prosecution of scientific research and special technical training, and so thoroughly imbued with the modern educational spirit, as is Tulane, should be here recorded at the earliest opportunity. The equipment of the Physical Laboratory, and the prominence given to the science of Electricity and to the course in Electrical Engineering under the direction of Professor Brown Ayres, evidences that the claim of the University that it keeps up with the advance of modern science is well founded. The fact that in creating a new University, these industrial, technical and artistic studies, which are advocated in the volumes of this Report, have been made so prominent, is a notable example of their importance and fully justifies the space here given to "Tulane."

The extracts showing the general features of the University will be given first. Those relating to the Manual Training School and the Free Drawing Class will close this chapter.

TULANE UNIVERSITY.

HISTORICAL STATEMENT.

The Tulane University of Louisiana, founded upon an endowment of the late Paul Tulane, was established by law by Act No. 43 of the session of 1884, which was ratified by a constitutional amendment April 17, 1888. By virtue of this legislation the administrators of the Tulane Educational Fund became administrators in perpetuity of the University of Louisiana, agreeing to devote their income to its development, and to establish thereon the Tulane University of Louisiana.

* * * * * * *

Col. Wm. Preston Johnston was selected in January, 1883, to organize an institution of learning under the terms of Mr. Tulane's donation. The acquisition of the University of Louisiana, with its franchises and valuable buildings, in 1884, gave practical shape to the purposes of the Tulane Board, and supplied the foundation

on which to establish Tulane University. It has now fourteen chairs in the University proper, and a High School Faculty, which, with its head master, has fourteen professors, assistant professors, and instructors. The collection of scientific apparatus, especially for instruction in physics and electricity, is quite extensive and of very high grade. The teaching is in great part by laboratory work, and the apparatus is better adapted to this method of instruction than any other in the South. There is a practical course in electrical engineering which has been pursued with marked success. The collection of dynamo machines is one of the largest in the country. The chemical laboratories have been carefully fitted up and are now in a fair state of efficiency, and it is hoped that many young men will be trained here to take part in developing the industries of the Southern States. The biological laboratory is well supplied with microscopes and the various kinds of apparatus needed for investigation as well as for ordinary study.

The line between university work and collegiate and academic work is sharply drawn. The latter is embraced in a series of equivalent curricula extending through seven years, three in the high school and four in the college, all leading to baccalaureate degrees, with or without distinction, according to attainment. The former is elective and of the most advanced character, and leads to the Degrees of Master of Arts, of Doctor of Philosophy, and to the Engineering Degrees.

A manual training school has been established. It is considered as the workshop or laboratory of the high school for technical training, but the college students in the engineering and scientific courses are expected to take a considerable amount of workshop practice. It is not intended to teach trades to young men, but to make them experts in the principles and handicraft of wood-working, iron and metal-working and machine construction. The appliances are as nearly perfect, and the scheme of instruction as thorough as in any institution in the United States. The effort is made to dignify and elevate labor without interfering with more abstract pursuits. No revolution in education is aimed at, but rather moral expansion and development through the cultivation of recognized and valuable mental and physical functions and activities; the whole system constituting a rounded and harmonious evolution of the student as man and citizen.

The libraries of the University, besides the State library of twenty-six thousand volumes, contain about twenty-five thousand volumes, with a certain fund for increase of some $2,000 per annum. The largest hospitality is extended to book-lovers and readers.

The institution is Christian, but not sectarian, and this is construed as extending the largest liberty of invitation to all who love the light of knowledge. The Tulane University is now on the sound basis of a living income, with a corporation secure in its tenure of office and consistent in its plans and purposes, and with the prestige of a State institution and popular favor to aid in its honorable career.

Important changes are contemplated in the location of the collegiate department of the university. A tract of land has been purchased fronting St. Charles Avenue and opposite Audubon park, where it is proposed to erect the necessary college buildings, laboratories, manual training shops and other annexes. Plans are being perfected and the work of construction will probably begin during the course of the summer.

The H. Sophie Newcomb Memorial College, for the higher education of white girls and young women, has been established as a department of Tulane University, through the munificence of Mrs. Josephine Louise Newcomb, widow of Warren Newcomb, of New York city. Through her noble liberality, it has been made one of the best endowed institutions in the Southern States.

Its first annual session was opened Thursday, October 16, 1887. Since that time, its progress has been steady, the number of students has been increased, the faculty enlarged, and important additions made to the apparatus for instruction. Oppor-

tunities are offered for a full collegiate course in literature and science, or for the special training of advanced students in ancient and modern languages, and on the lines of special work. Extensive and well shaded grounds afford opportunity for open air exercise and recreation. The main building is a spacious and handsome structure. The libraries and laboratories afford valuable aid. The laboratory for physics and chemistry is a new brick building, well equipped with apparatus; and superior facilities are offered to young women for securing a practical knowledge of these studies.

In various branches of art much zeal has been developed and satisfactory progress made.

There is a preparatory department, of high school grade, which fits students for admission to the College.

Occupying an entire square in one of the most beautiful and cultivated sections of the city, Newcomb College aims to secure the objects of higher female education—thorough and accurate scholarship, the best conditions of physical culture, the wisest and most healthful intellectual and moral aspirations.

The Free Drawing School has been in successful operation, for seven years past, under the auspices of the university. The professors engaged in the work have cheerfully given their time and talents, and much good has been done in the instruction of the students for technical and industrial pursuits, and in fostering and diffusing a taste for art in the community. The classes are mainly attended by those who wish to acquire a thorough knowledge of the fundamental principles of art, and by those who find a knowledge of the different branches of drawing useful in their daily employment. Though not strictly university work, it yet has the spirit of university extension, and the good results attained from year to year have abundantly justified the efforts in its behalf.

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PLAN OF EDUCATION.

Tulane University is an institution for the higher education of the white youth of Louisiana. The administrators of Tulane University, recognizing the great fact that education is a unit, integral from its very nature, and looking to the actual conditions of things in Louisiana, find themselves obliged to embrace in their scheme a plan broad and deep, and to institute for the successive phases of educational development, a High School, a College, and a University Department of Philosophy and Science. Taking the youth on the threshold of the higher education, this plan proposes, through judicious instruction; to train him to know, to do, and to be, and thus to develop a consistent manhood by means of his harmonious and equable evolution of body, mind, and soul.

Tulane University of Louisiana is divided into the University Departmennt of Philosophy and Science, Tulane College, Tulane High School, H. Sophie Newcomb Memorial College for Young Women, the Law Department, and the Medical Department.

UNIVERSITY DEPARTMENT OF PHILOSOPHY AND SCIENCE.

If the student in a college should feel and act as one under authority, the graduate of the college who enters upon his university career in the Department of Philosophy and Science should recognize that he is called to a higher culture, which does not simply permit, but demands, liberty of choice, the exercise of independent thought, an earnest attempt at original investigation and individual conviction. Herein he must receive the inspiration of the scientific spirit and pursue his studies by the scientific method, under the guidance, but not under the authority, of a professor.

Acting upon this view, we differentiate sharply between the work of the College and the work of the University in its higher department.

We leave to the College the disciplinary work of education to be pursued by collegiate or gymnastic methods. We reserve for the students in the Department of Philosophy and Science that higher culture pursued in the scientific spirit, which is true University work. If few in number, yet these University students must be College graduates, not merely College students graded as University students.

We admit to our University, as candidates for degrees, the graduates of our own and other colleges with fairly equivalent requirements, and such other persons as shall pass a satisfactory examination on branches of knowledge and studies fully equivalent.

Degrees.—Graduates of Tulane College and other accepted candidates who shall pursue for two years an apppoved course of study in three branches, one major and two minor, selected by the student and approved by the Faculty, and who shall pass a satisfactory examination and present a written thesis acceptable to the President and Faculty, will receive the degree of Master of Arts.

The degree of Doctor of Philosophy will be given for a further prescribed, or approved, course of study in Tulane University, pursued for two years more under like conditions and with such excellence and superior attainments as to warrant it.

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Graduates of the H. Sophie Newcomb Memorial College or female graduates of other accredited colleges of the first grade who have received the degree of A. B. or B. S. may be admitted to the privileges of University instruction, and shall be entitled to the A. M., or a technical degree, upon the completion of a course of study equivalent to that required of male graduates.

All University courses of study shall be assigned, approved and conducted by the University Faculty.

The University Faculty consists of the President, the Secretary, the President of the H. Sophie Newcomb College, the Director of the Manual Training School, the Head Master of the High School, and the Professors filling the chairs of Metaphysics, Latin, English, and Greek, History and Rhetoric, German, French, Mathematics, Physics, Applied Chemistry, Chemistry and Geology, Drawing, Biology, and such others as may from time to time be added by the Board of Administrators.

TULANE COLLEGE.

Tulane College covers, with four years of solid collegiate instruction and training, the second great phase of liberal education. Its purpose is to train and discipline the students for the professions or for leadership in the superior walks of the manifold and ever widening spheres of active life.

To attain this high aim, every faculty of the mind must be disciplined to work efficiently to its appointed ends. And for this discipline every grand division of the complete sphere of human knowledge should be represented in a rounded plan of academic education. Philosophy, History, Mathematics, the Physical Sciences, Biology, and the Languages, which are the expression and embodiment of human thought, all serve as necessary agents in a harmonious evolution of intellect and character, and should all be represented in any scheme or course of study which pretends to give a complete liberal education. To assume, however, that there is only one course which shall do equally well for all, no matter what their intended careers may be, is a mistake.

Not trusting in the ability of immature students, or even of parents who have seldom duly considered the subject, Tulane College now offers four courses of study, with prescribed branches, each leading to a baccalaureate degree. These courses, though directed to different pursuits in life, are parallel and almost substantially equivalent in the amount, proportion and exactness of the training and instruction afforded.

In the grouping and succession of studies in these courses, while opportunity is afforded for information in all the great realms of human knowledge adequate to a liberal education, still greater regard is had to that rigorous training of the faculties which devélops intellectual energy and moral power. It is intended that the degrees which crown these four courses shall be an honest testimonal to solid acquirements in knowledge and intellectual discipline.

The difference in the courses is chiefly in the amount of the particular branches pursued, and in the substitution of studies nearly equivalent in amount, and as nearly so as possible in intrinsic and disciplinary value to the students.

The courses are denominated respectively, Classical, Literary, Scientific and Engineering. Each has four classes, which retain the time-honored names of Freshman, Sophomore, Junior, and Senior. In each course of study, and in each year of that course, it has been sought, by proper and logical arrangement of studies, to carry forward the instruction and the training to a given practical end.

The degree of Bachelor of Arts is conferred for the successful accomplishment of the Classical or Literary Course, and the degree of Bachelor of Science, for the satisfactory completion of the Scientific or Engineering Course, and students of extraordinary merit may have added to this, "with distinction."

Classical Course.—In the Classical Course an effort is made to preserve the foothold of the ancient languages, Latin and Greek, and to afford to the student willing to submit to their invaluable and unsurpassed mental discipline the opportunity to obtain a solid classical education.

This course is specially recommended to students aiming at the learned professions.

Literary Course.—The Literary Course differs from the Classical chiefly in the omission of Greek and the substitution of fuller courses of Latin, German and French.

Scientific Course.—In the Scientific Course the instruction in English and Modern Languages, and in Political Science and Psychology, is very similar to that in the Classical and Literary Courses. Instead of Latin and Greek are substituted a fuller course in Mathematics and an extended course in Physics, Chemistry and Biology, with two years laboratory practice in each.

This course is especially adapted to those who intend to study medicine or pharmacy, or to become Analytical Chemists, or who intend to devote their lives to any more purely scientific work.

Engineering Course.—The Engineering Course differs from the Scientific in the greater prominence given to the industrial applications of the sciences, to manual training and drawing, and to special technical work in the direction of the student's inclination.

This course is adapted to the needs of those who intend to become Civil, Mechanical, Electrical, Mining, or Chemical Engineers, or Architects. In the Senior Year the equivalent of eight hours a week of class work may be selected by the student, with the approval of the faculty, from a number of electives. This is designated in the scheme of studies as "Special Technical Work." The subjects from which selection may be made are Theory of Tools and Materials of Construction, Chemical Laboratory, Physical Laboratory, Applied Electricity, Applied Chemistry, and Civil Engineering and Architecture.

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DRAWING.

Professor Woodward.

The drawing of the High School is continued in the Scientific and Engineering courses of the College. In the Freshman year the studies are as follows: Sketching, measuring and drawing machinery; Isometric drawings with shadows in line

and color; freehand studies of Historic Ornament in line and color; modeling ornament and proportion of human face in clay.

In the Engineering course, the Sophomore class study Geometric curves and form the various styles of gear wheels by the cycloidal method, draw arrangements of belting, form and action of cams, etc. The theory and practice of shadows by orthographic projection, tracing the classic orders of Architecture, or examples of machine drawing, followed by making blue prints of the same, are included in the work of the second term.

Drawing plans, elevations, and perspectives of buildings will be taught to students who have not received such instructions before entering the College.

Plotting and coloring drawings for Civil Engineering are provided for.

Sophomore Scientific students spend the year in freehand drawing and coloring from natural objects of interest.

MECHANICAL WORK.

Professor ORDWAY.

In the Scientific and Engineering courses the shop work of the High School is continued through the Freshman year. In the Engineering course it runs through the Freshman, Sophomore, and Junior years. This advanced work includes forging, brazing, chipping and filing iron, and lathe work. In the Senior year the students of the Engineering course attend lectures on Tools, Manufactures, and Materials of Construction.

For those who are looking forward to the profession of mechanical engineering, opportunity is also offered for experimental work, in the production, managing, and testing of steam, and in the use of the steam engine indicator.

The shop work, drawing, and some experimental work are carried on in the well-lighted and ventilated building at the corner of Lafayette and Dryades streets.

The carpenter shop is furnished with thirty independent benches, each supplied with a set of all the tools required. The wood-turning room, which receives power from below, is provided with thirty lathes and pattern-making benches, two jig saws, a grindstone, a large pattern-maker's lathe, a buzz planer, and a circular saw. The last two machines the students are not allowed to use, except under the immediate supervision of the instructor.

The forge room contains thirty forges, with fan blast and smoke-exhausting arrangement. The machine room contains the steam engine, a grindstone, a machine drill, a hand drill, an iron planer, a shaper, an emery wheel, and a buffing wheel, six engine lathes, six speed lathes, and fifteen vise benches. The wash room, in the rear of the dressing room, is supplied with hot and cold water.

A tinsmith's shop has been annexed, so that the students, during the warm months of the school year, may have practice in soldering and brazing instead of the heavier work of forging.

To every student of the Engineering course is given a liberal hand work training—that is, he is not allowed to take only one branch, but he is expected to work at all the different branches in succession; carpentry and joinery, wood-turning and pattern-making, with some wood-carving, forging, chipping and filing iron, soldering and bracing, and the use of machine tools in working iron, steel, and brass.

Thus the student not only learns how tools are used, but he also gains a practical understanding of the nature and limitations of materials. The shop work affords intellectual discipline, as it requires thought in planning and exactness in execution. It furnishes healthful bodily exercise and gives one confidence in his own constructive ability.

Though, from the educator's point of view, the utilitarian or economic aspect of hand work may be of little importance, yet no study or school exercise can be looked on as any the worse because it admits of application to matters of real life. Work shop practice is really a highly valuable part of engineering laboratory work.

H. SOPHIE NEWCOMB MEMORIAL COLLEGE.

The H. Sophie Newcomb Memorial College is devoted to the higher education of young women. It was founded in 1856, by Mrs. Josephine Louise Newcomb, as a memorial to her daughter. In pursuance of the design of its founder, it has adopted a system of instruction which is believed to be liberal and thorough.

The location in the city of New Orleans is an advantageous one on account of its accessibility from all parts of the South, the educational facilities to be enjoyed in its libraries and museums, and the mildness of its climate throughout the college year. Erroneous impressions concerning the healthfulness of this city are gradually being corrected, and each succeeding season brings from the North and East a larger number of winter residents. A comparison of medical records discloses the fact that the health of New Orleans is not surpassed by any other large city in the United States; it has had only two epidemics of yellow fever in the past thirty years, both occurring in the vacation months; and the experience of the past fourteen years has demonstrated that this disease can be effectually excluded.

The climate of New Orleans offers peculiar inducements to those who find it difficult to endure the severe and changeable weather of the Northern States. By reason of its position, which is practically insular, the city is protected alike from the extremes of cold and heat that occur throughout the greater part of the Mississippi and Ohio valley; a freezing temperature is seldom reached in winter, and the heats of summer are tempered by the constant Gulf breezes; life in the open air is pleasant throughout the college year, and the students enjoy an immunity from colds and many pulmonary and nervous ailments which are caused or aggravated by the severity of Northern winters.

LOCATION.

The college buildings occupy a large square, several acres in extent, on Washington avenue, Camp, Chestnut, and Sixth streets, in the choice residence section of the city. The beauty of its situation and surroundings is unsurpassed in the city. Its extensive grounds, shaded by numerous live oaks, palms, and other trees and shrubbery, afford ample opportunity for open-air recreation.

Besides the various class and study rooms, the main building contains a chapel, a memorial room, a large assembly room and lecture hall, capable of seating an audience of 700 or 800, and numerous art studios. The physical, chemical, and biological laboratories are placed in a separate building.

Scholarships—Mrs. Ida A. Richardson, of New Orleans, having generously donated the sum of $1,500 for the endowment of a scholarship to be known as the Cora A. Slocomb Scholarship in the College, to be filled by a graduate of the New Orleans Public High Schools, the Board of Administrators have adopted the following regulations upon the subject:

1. The Cora A. Slocomb Scholarship in the H. Sophie Newcomb Memorial College is offered as an award to a graduate from one of the New Orleans Public High Schools on the following conditions:

2. The scholarship will be awarded to the applicant who shall make the highest record in a competitive examination to be held at the college on the date fixed by its catalogue for the beginning of its session.

3. Only those will be considered eligible who are qualified for admission to one of the regular college courses, who have been members of the class last graduated from one of the High Schools, and who are recommended by its principal.

4. The examination shall be in writing, and shall be conducted by the faculty of the H. Sophie Newcomb Memorial College, or by those whom it may appoint for the purpose.

The first appointment to this scholarship was made at the opening of the session

of 1891–92, and was awarded to Miss Isoline Rodd, graduate of the McDonogh High School No. 2, Class of 1891.

Mr. B. C. Wetmore, of New York City, has donated $1500 to found a scholarship, subject to the same conditions as apply to the Cora A. Slocomb scholarship. This is to be known as the B. C. Wetmore Scholarship. The first appointment to this will be made at the opening of the next session, October, 1892.

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COLLEGE COURSES OF STUDY.

Students of the college may select any one of the three courses of study, the Classical, Scientific, or Modern Languages, each of which presents a well rounded curriculum, and leads to the degree of Bachelor of Arts.

The satisfactory completion of special or optional studies will be rewarded with a special certificate, setting forth the amount of work accomplished.

On examination of these courses of study, it will be noticed that special prominence has been given to the study of art, which is required in certain amount of all students not signally disqualified. No extra charge is made for this study, and it may be continued as far and in as many directions as the time and inclination of the student and the judgment of the faculty may permit. These opportunities are offered in the conviction that the advantages to be derived are of the highest value in the cultivation of correct taste, at the same time that it offers desirable relaxation from the more exacting work of the class room.

No idea can be more mistaken than that art education has for its object the preparation of the student for the vocation of an artist. Its successful pursuit does not, therefore, depend upon special talent any more than in the case of mathematics or the languages; but, like them, is designed to develop and strengthen faculties which otherwise might not be discovered. Simply stated, the study of art has a twofold purpose. On the one side it trains the eye and hand and develops the sense of mastery over material; on the other it cultivates an intelligent appreciation of the beautiful through the study and imitation of masterpieces of art, and in original design. Attention is here called to the Normal Art Course, which is believed to offer advantages of opportunity and instruction unequaled in the South and unsurpassed in the United States.

SPECIAL STUDENTS.

Although students are strongly urged to take one of the regular courses, it may nevertheless occur that, for various reasons, some will decide to pursue a partial course, or confine their work to a single branch. For such special students provision will be made, and each one who shall complete with credit the work prescribed in any study shall be entitled to a certificate of excellence. These special courses will be of value to those who intend to prepare themselves for teaching some particular branch, or those who, having completed their school or college career, nevertheless are unwilling to abandon further intellectual pursuits, and desire to devote a part of their time to the prosecution of some favorite study In addition to the special courses in Language, Chemical and Physical Laboratory and Art, Lecture Courses in French and English Literature, in History, and in Psychology will be given during the second and third quarters of the coming session.

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ART IN COLLEGE COURSES.

Freshman Year: Constructive and Geometrical Drawing; Freehand Perspective; Elements of Design—Study of Plant Forms.

Sophomore Year: Drawing from Casts and Models. Projection of Solids and Shadows; Decorative Design; Mechanical Perspective.

Junior Year: Mechanical Perspective; Shadows and Reflections; Decorative Design; Cast Drawing; Sketching; Drawing from Life; History of Art.

[For optional study in art see Normal Art Course.]

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SPECIAL NORMAL ART.

A course in normal art is provided, designed to prepare teachers. It unites the study of fine and industrial art, and gives special attention to methods of public school art instruction. It extends over four years. Applicants for advanced standing should be thoroughly qualified by previous study and training for entering the desired grade.

A certificate is given at the close of each year.

Although this course is designed to prepare teachers, it is calculated, with the omission of a few subjects, for any student desiring a systematic training and preparation for the pursuit of fine art. Too much can not be urged in favor of the superiority of graded instruction over the desultory pursuit of special subjects. This fact, so easily admitted in academic studies, is too often disregarded in the study of art.

First Year. Study of form with Line and Clay, Cast Drawing, Freehand Perspective, Drawing from Plants, Elements of Design, Elements of Shading in Charcoal, Geometry-Plane, Constructive Drawing.

Second Year.—Mechanical and Freehand Perspective, Sketching, Shading from Casts and Models, Drawing from Plants, History of Ornaments, Elements of Decorative Designs, Plane Geometry, Projection of Solids, Systems of Public School Drawing, Shading in Wash.

Third Year.—Mechanical and Freehand Perspective, Shading Casts in Charcoal, Water Color, Harmony and Chemistry of Color, Color Design, Drawing from Life, Constructive Design, Projection of Shadows, History of Sculpture.

Senior.—Anatomy of Human Figure, Oil Painting, Drawing and Painting from Life, Modeling in Clay, Casting, Design for Reliefs, Wood Carving, Pen Drawing and Etching, History of Painting, Practice in Teaching.

ELECTIVE ART WORK.

In speeial art the studies are elective. A separate studio, equipped with all necessary fittings, is provided for each study.

Perspective and Model Drawing—These studies are fundamental, and form a part of all courses except those directed exclusively to design.

Cast Drawing—The cast drawing and light and shade room is completely furnished with selected plaster copies of antique statuary and reliefs.

Water-Color Painting—Every facility is given for still life and figure painting, according to the best methods for securing independent results and a broad style of handling.

Oil Painting is conducted by study from composed groups, and from life.

Design—As the most important study in the useful arts, careful attention is given to design. After the study of the theory has been mastered, efforts are directed to its practical application.

Modeling and Casting—Exceptional opportunities are offered for the practical study of terra cotta modeling. The practice of plaster casting is also provided for.

Wood Carving.—Wood carving and clay modeling, as means of training the hand to strength and deftness, are invaluable. Applications of carved designs to useful articles are made as soon as sufficient excellence is obtained.

Life Drawing—Head and Draped figure.

It is believed that drawing from life should begin as soon as a fair proficiency is attained in elementary work. Efforts are directed toward a serious, strong and

accurate style of drawing and painting, and a knowledge of anatomical structure. The grounds about the college afford excellent opportunities for sketching from nature.

THE LIBRARIES.

Three distinct Libraries are under the charge of the University, First: The Tulane Library, comprising about 14,000 volumes and constantly added to, both by purchase and, also, as it is the authorized depository of United States public documents.

The Medical Section numbers about 2,700 volumes, and there are about 5,000 volumes of Public Documents.

The Fisk Library contains 12,500 volumes, and is growing at the rate of 500 volumes a year. This is a library of general literature and has a public reading room open during the day.

The State Library, of 26,000 volumes, is deposited in the Law Building of the University and students have free access to it. This is largely a law library.

MUSEUMS.

The University Museum comprises departments of Mineralogy, Geology and Lithology, Botany, Zoology, Anthropology.—A small collection of curios, and two mummies; and an Educational and Economical Department. The collections in Botany and Mineralogy are very full—the other departments are incomplete.

ART MUSEUM.

Professor William Woodward, Art Director.

LINTON-SURGET HALL.

The cherished desire of the Administrators of Tulane University for the inauguration of a Museum of Fine Arts has been gratified by the auspicious donation of the late Mrs. Eustace Surget, of Bordeaux, France. Mrs. Surget, née Mary Linton, was a native of this city, and passed much of her early life here. In her last will she expressed the wish to her sister, Mrs. C. B. Surget, widow of Francis Surget, that her books, statuary, paintings and objects d'art should be donated to the city of New Orleans, on certain terms and conditions. At the request of Mrs. C. B. Surget, the Mayor and Council of the city of New Orleans, by an ordinance, approved May 18, 1889, made Tulane University the perpetual depository for the care and custody of the donation under the terms of the bequest, provided that the city should be put to no expense and made liable to no costs. Therefore, under the conditions of the bequest, two rooms have been set apart in Tulane University, to be designated and known as the "Linton-Surget Hall," for the care and custody of this donation, which embraces about 1000 volumes, principally works on art; two statues, and forty-five valuable paintings.

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Mrs. C. B. Surget, of Bordeaux, France, has added to the above collection two valuable statues by Crawford and the seven valuable historical portraits of distinguished Americans. * * *

Mrs. V. C. Montgomery of New York, the widow of Mr. R. W. Montgomery, a

much esteemed citizen of New Orleans, has given to the Tulane Art Museum a marble group of great beauty and value as a memorial of her husband."

The permanent collections receive additions by gift from year to year. Loan collections are also exhibited; and twice a year,—at the Carnival Season, and at close of June session, a public exhibition is opened of the University collections, and of works of artists and amateurs who may wish to contribute.

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UNIVERSITY EXTENSION.

The principles of University Extension have been in active operation in Tulane University for several years past. During the seven annual sessions of the Free Drawing School nearly four thousand students, male and female, have received systematic and continuous instruction in various branches of drawing from the professors of the University. In seven years past, there have been public lectures, singly or by series, on various literary and scientific subjects, the lecturers being members of the Tulane Faculty, or eminent scholars and educators invited from other places for the purpose. During the past session the work has been pushed forward and broadened in different directions of study. The popular call for a movement which should be more technically in the line of University Extension was cheerfully met by the Faculty of Tulane, and six courses were offered to the public and accepted by classes sufficiently large to encourage the lecturers and guarantee the success of the movement. About 380 persons were registered for all the courses, and notwithstanding the difficulty of controlling time in the crowded engagements and pressing actualities of city life, the interest was retained and the audiences continued in good numbers until the close. In addition to the work of the Tulane Faculty in this direction a lecture was given by Professor Thomas Fitz-Hugh, of the University of Texas, on "Cicero and His Murderers."

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For the season of 1892–93 the following courses are proposed:

Six lectures on The Last Century of the Roman Republic, by Prof. Dillard.

Six lectures on Certain French Writers of the Nineteenth Century, by Prof. Fortier.

Six lectures on German Literature, in German, by Prof. Deiler.

Six lectures on the history of Chemical Theory, by Prof. Caldwell.

Six lectures on Biology, by Prof. Orr.

Six lectures on Food, by Prof. Ordway.

Additions may be made hereafter to the above list.

It is but just to say that the Faculty of Tulane University have entered fully into the spirit of literary and scientific activity which is a prominent characteristic of the present age. The Louisiana Folk Lore Association, a branch of the American Folk Lore Society, has a large and zealous membership and holds its meetings in the College buildings. The New Orleans Academy of Sciences, founded in 1853, has been closely allied, for several years past, with the scientific work of the University. Its place of meeting and the depository of its archives, books, periodicals, and scientific collection are in the University building. The Athenée Louisianaise, a society formed to promote the study of the French language and literature has its library in a room of the College building. For two years a club has held weekly meetings, in the College buildings, during the winter months, for the critical study of Robert Browning's works. A club prosecuting physiological and psychological studies meets, from time to time, in the Biological Laboratory of the College.

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LOCATION.

The buildings, which belonged to the University of Louisiana and which subsequently became the property of the Tulane University, are large and commodious, on the square bounded by Canal street, Tulane avenue, University Place and Baronne street. Of these four buildings, two are occupied respectively by the Academical Departments, one by the Medical College, and the fourth by the Law School and by the State Library.

The Manual Training School is conveniently located in the building corner of Lafayette and Dryades streets, and was purchased by the Administrators of the Tulane Fund for the convenience of this branch of instruction.

The liberal endowment of the H. Sophie Newcomb Memorial College by Mrs. Newcomb has been augmented by her purchase of the beautiful property known as the "Burnside Place," as a permanent location for the College. In many important particulars the property is unexcelled. The grounds cover an entire square, embracing some four acres, on Washington street, between Chestnut and Camp, and are convenient of access by several lines of cars and in the midst of choice residences, with the surroundings favorable for school work. The beauty and attractiveness of the property are well known. This generous act of Mrs. Newcomb places the College for women upon a secure foundation with brilliant prospects for the future.

The wisdom of founding seats of learning in centres of population is beyond dispute. The Tulane University of Louisiana is located at the doors of nearly 250,000 people—almost the third of the population of the State; and the rapid increase in the railroad and other transportation facilities of New Orleans is making it every day more and more accessible from all quarters.

Notwithstanding the occasional outbreaks of yellow fever, the last of which occurred in 1878, New Orleans is perhaps the healthiest city of its size in the United States. Epidemics have visited it only at intervals of years, and then only in the summer vacations, and, possibly, in the month of October. They can scarcely interfere, therefore, with the practical working of the University.

ATTENDANCE.

During the session of 1891–92 the attendance in the different departments of the University was as follows:

High School	191
University and College	118
H. Sophie Newcomb Memorial College	178
Free Drawing School	333
Law Department	49
Medical Department	415
Total	1284

The following is a list of the Faculty and Instructors of the University in 1891–1892, who have special charge of the courses in Physics, Drawing, Manual Training and Art in the two colleges.

Wm. Preston Johnston, LL. D., President of the University.

Brown Ayres, B. Sc., Ph. D. (Stevens Institute), Professor of Physics and Astronomy.

John M. Ordway, A. M. (Dartmouth), Professor of Applied Chemistry and Director of Manual Training School.

Ellsworth Woodward (Massachusetts Normal Art School), Professor of Drawing. Newcomb College.

Evelyn W. Ordway, B. S. (Massachusetts Institute of Technology), Professor of Chemistry and Physics. Newcomb College.

Gertrude Roberts, Assistant Professor of Drawing and Painting. Newcomb College.

Frederick O. Sylvester, Assistant Professor of Drawing. Newcomb College.

Allison Owen, Assistant Professor of Drawing.

Otis Atherton, Instructor in Iron-Working.

Julius Porbes, Instructor in Wood-Working.

Wm. Woodward (Massachusetts Normal Art School), Professor of Drawing.

Henry Porbes, Instructor in Wood-Working.

William von Phul, B. S., Instructor in Physics.

Tudor T. Hall, Mechanician in Department of Physics.

SUMMARY—FACULTY AND INSTRUCTORS.

President and Professors	38
Assistant Professors	6
Lecturers and Instructors	31
Mechanician	1
Total	76

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H. SOPHIE NEWCOMB MEMORIAL COLLEGE.

ATTENDANCE FOR 1891–'92.

Post Graduates	7
College:	
Seniors	5
Juniors	16
Sophomore	14
Freshman	30
Preparatory Classes	59
Special Courses:	
Literary	24
Art	30
Total	185
Less names duplicated	7
Number of Students	178

The Faculty of the H. Sophie Newcomb Memorial College, consists of nineteen Professors and Instructors, the names of the President and of the Professors having special charge of the courses herein referred to are given.

Brandt V. B. Dixon, A. M., President and Professor of Mental Science.

Ellsworth Woodward, Professor of Drawing and Painting, and Director of Art Instruction.

Gertrude Roberts, Associate Professor of Drawing and Painting.

F. O. Sylvester, Assistant Professor Drawing and Painting.

The Manual Training Instruction is given in connection with the High School and is a part of its course. Some of the catalogues

have contained illustrations of the Manual Training and Wood Carving rooms, which will be given here if the plates can be obtained for use in this Report. They are well and fully equipped.

TULANE HIGH SCHOOL.

Three years are allotted to the academic life of the High School, which should fit the pupil for the College, or for an ordinary practical business career. Throughout the High School the attempt will be made toward a normal adjustment of that physical, mental, and moral training which is so much praised and so little practised. The hand, the eye, and the muscles are trained by handwork in wood, which is now admitted to be the true basis of the best mechanical education, and is claimed to confer so many other benefits. We recognize in it a most useful adjunct in all efforts for a harmonious human evolution, and that it has its place in all thoroughly coördinated schemes of education.

The purpose throughout is *training;* the means employed are those branches best adapted to considerable bodies of students. But we do not expect or desire manual training to supersede, or to be substituted for, other well established courses of training sanctioned by the experience of wise and conservative men. Our motto is, "Evolution, not Revolution."

Hence the Manual Training School is not a separate department of Tulane University, but the laboratory in wood and iron, where instruction and practice render the student quick, observant and accurate with the eye, ready, skilful and exact with the hand, and able to think *in* things as well as *about* them, and to execute as well as to describe.

In this physical and mechanical training, drawing is considered fundamental, and enters into every course. All students who enter the High School learn to draw as a matter of general instruction, while those who propose to follow a mechanical or engineering career must necessarily study with reference to its practical application—carry it to its last results in the applied arts.

Penmanship and Accounts are also taught as practical studies.

Another branch of knowledge which every student is taught is Physiology and Hygiene. It is taught by lectures especially adapted to the age and advancement of young students, and by examination on suitable text-books, and it is believed that this instruction will result in incalculable good.

Instruction in the High School is given in two parallel and equivalent courses of study, to-wit: 1st, Classical; 2d, Literary and Scientific.

The studies to be pursued in each course are contained in the schedule hereto annexed.

The High School proposes to give an education which shall be exact and thorough, and shall fit the pupil for a further College Course, or for an entry on the apprenticeship of a practical career.

There are three classes, which are termed Preparatory, Intermediate, and Sub-Freshman. To enter the High School there is required a good elementary education in Reading, Writing, and Arithmetic, including percentage and its applications, with the ordinary school knowledge of Geography and History, and the elementary principles of English Grammar.

In the Preparatory Class all the students have the same studies, which diverge slightly in the Intermediate Class, where French is substituted for Greek, as will be observed by referring to the Schedule of Courses of Studies. But in both the courses, except in the Preparatory Class, English and two other languages, Mathematics, some elementary Natural Science, Drawing and Wood-Working are required.

More than three hours are given to recitations, and an hour and a half to Manual Training or Drawing, daily, except Saturdays. Studies will be carried on in study

rooms under the supervision of competent instructors. The exercises open at 9 a. m. and close at 4 p. m.

No student can enter any class, or pass to a higher one, without being fully prepared for it, and without evincing this preparation by a satisfactory examination.

The student who finishes either one of the regular courses of the High School will be entitled to a Diploma; and, if he has attained superior excellence, he will be granted a Diploma with Distinction.

The High School Faculty includes several of the Professors of the College, who are thus able to prosecute a continuous course of instruction in the branches with which they are most familiar and to secure the best preparation for higher work.

The other courses are similar to those in the best High Schools. The following extracts contain all that is said in this catalogue of the courses in Manual Training and Drawing:

MANUAL TRAINING.

As Manual Training is found to be a valuable adjunct to intellectual cultivation, a considerable amount of practice in wood-working is required even in the Classical Course of the High School. The work proceeds step by step from the easier to the more difficult operations, and is calculated to impart a fair degree of skill and a general practical knowledge of tools, materials, methods, and principles, rather than that nicety of execution which can be acquired only by long, time-consuming practice within a limited range.

The exercises are selected with reference to healthy muscular development, and by a suitable alternation of shop-work with classroom studies, the pupil is enabled to make more real progress in intellectual growth within the school years than can be gained by fatiguing devotion to study alone. The interest of the student is stimulated by keeping in view utility or beauty in the objects constructed. The workshop manipulations constitute an excellent preparation for subsequent laboratory practice of all kinds. And, should the student be obliged to terminate his training with a high school course, the manual training will be of great advantage in fitting him for his life-work in whatever occupation he may engage. Education in which the manual element has a share is particularly suitable for those who are to assist in developing the industrial resources of the country.

DRAWING.

Drawing is considered as a language or mode of expressing ideas, and, therefore, not less important than linguistic study, on account of its disciplinary as well as its direct practical value. High School pupils are taught more or less of free hand or mechanical drawing and design, according to the needs of the two courses. While the artistic side is not altogether neglected, attention is directed mainly to the industrial aspects of the subject. The exercises consist mostly in drawing directly from the objects, while the pupil is also instructed in the various auxiliary geometrical problems and the conventional devices which facilitate clear expression. The student is expected to observe constantly the relation of the object to the mode of its representation and to become self-directing without wasting time in copying the delineations of others. As the work advances the imagination is cultivated by the consideration of projections and shadows, and by drawing ideal sections, by sketching from memory, and by making original designs.

For the mechanical drawing each one must provide himself with a set of drawing instruments and other materials.

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TULANE HIGH SCHOOL FACULTY, 1892–1893.

Ashley D. Hurt, A. M., Head Master of High School and Professor of Latin.
John M. Ordway, A. M., Director of Manual Training School.
Lyman C. Reed, A. M., Professor of English.
John R. Ficklen, B. Let., Professor of History.
William Woodward, Professor of Drawing.
George Gessner, A. M., Professor of Greek.
J. W. Pearce, A. M., Ph. D., Professor of English and Mathematics.
Edward Dessommes, Assistant Professor of French.
D. R. Buchanan, Assistant Professor of Book Keeping and Penmanship.
Henry E. Chambers, Assistant Professor of Mathematics and Natural Sciences.
Allison Owen, Assistant Professor of Drawing.
Julius Porbes, Instructor in Wood-Working.
Henry Porbes, Instructor in Wood-Working.

It is in the Free Drawing School that the Tulane University, of Louisiana, falls into line with those benevolent institutions of the North already recorded in this volume, and ranks, in its usefulness to the community, with Cooper Union, the Pratt Institute, Drexel Institute, and the Maryland Institute, as well as with the several City "Mechanics Institutes;" thereby proving itself to be, in fact, a "Peoples University."

FREE DRAWING SCHOOL.

CORPS OF TEACHERS, 1891–1892.

Professor Wm. Woodward. Assistant Professor Allison Owen. Instructor Wm. G. Trimble.

The Free Drawing School of Tulane University has now completed the seventh year of its work. It is believed that its success has justified its establishment. While it has been somewhat apart from the strict line of University work, the immediate benefits it has conferred upon the general public in the elevation of popular intelligence, and in the special training of individuals in both practical and æsthetic matters, in industrial drawing and the fine arts, can not be overlooked. Nearly four thousand students appear upon its rolls, and, allowing for double counting more than 2500 different persons have received gratuitous instruction in these classes. So far no one has been denied admission to the classes who came within the definition of bread-winner, and indeed the only restriction placed upon entrance has been immaturity in age, or incompatible duties. In addition to the fundamental instruction in Drawing, higher grades of work have been pursued in Mechanical and Architectural Drawing, Drawing from Nature, Free Hand Drawing, Drawing from Casts and Design.

The following is the report of the Classes for 1891–92:

SATURDAY CLASSES FOR WOMEN.

Drawing, Advanced Perspective	13
Drawing, Elementary Perspective	51
Mechanical Drawing, Elementary	5
Mechanical Drawing, Advanced	3
Architectural Drawing	3
Design	7
Historic Ornament	23
Sketch Class	18
	123

EVENING CLASS FOR MEN.

Sketch	4
Free Hand, Senior	2
Free Hand, Junior	8
Free Hand, Elementary	21
Mechanical, Junior	5
Mechanical, Elementary	48
Architectural Drawing, Junior 12, Senior 4	16
Preparatory Class, Men	61
Preparatory Class, Boys	45
	210

Total admission for session 1891–92	333
Total admission for seven annual sessions	3887
Total number of students finishing their classes	1330

For the session of 1891–92, ninety certificates have been issued, as follows: Distinguished 36, Meritorious 48, Satisfactory 6. No certificates are issued for work done in the Preparatory classes.

The Free Drawing School will hold its next session at the Tulane Manual Training School, from Saturday, October 29, 1892, till May 13, 1893, four nights in the week and on Saturdays. There are night classes for men and youths, employed during the day with their regular work, trades or business. Each of these classes will meet two evenings in the week and will be occupied from 7:30 to 9 o'clock P. M.

Beginners enter the Preparatory Class, in which both free hand and mechanical drawing are taught. Having completed the work of this class, the students may choose between the Free Hand and Mechanical Drawing courses, or may attend both.

THE MECHANICAL COURSE

is intended to aid mechanics who are striving to improve in their work. It has three classes, Elementary, Junior, and Senior. Students of those classes have gratefully acknowledged the benefits of their instruction, as evinced in larger views, better wages, and new avenues to employment.

Students who have finished the Elementary Mechanical Class in Drawing may enter the Architectural Course, which embraces two years, Junior and Senior.

Some of the students of these classes have obtained remunerative positions as draughtsmen or as teachers in good institutions, the result of their success in these classes.

FREE HAND COURSE.

This course has three classes, Elementary, Junior, and Senior. Students who have completed the Preparatory may enter the Elementary Free Hand Class, if they so select. In this course the elements of perspective and shading, practice from casts and natural objects, and the anatomy of the human figure are studied, and much attention is given to the careful study of form in general and the human form in particular. The history of the leading styles of ornament is also pursued.

This course thus prepares students for illustrators and designers, and lays a foundation for future art studies. A thesis on the History of Architecture and Ornament is required in the Juuior Year, and one on the History of Sculpture and Painting in the Senior Year.

The Senior Free Hand Class devotes its attention mainly to the analysis of the human form. Modeling the various parts in clay is also employed as a valuable

aid for the artist or figure designer, and as tending to develop a latent taste for sculpture.

SATURDAY CLASSES.

These classes have been largely attended by both women and men, chiefly by women. They were at first intended principally to aid the teachers of the public schools, but their scope has been enlarged, and they now lead both to the Fine Arts and the practical uses of the Industrial Arts.

It is intended in these classes to lay a solid foundation for both the Fine and Industrial Arts, by correct instruction and practice in Drawing and the immediate cognate arts resting on Design, Color, and Ornament.

Students may enter the Elementary Perspective, Elementary Design, Elementary Mechanical Classes, or may attend two of these classes if they desire.

A two years' course is offered in any of the above classes. The advanced, or second year, classes, continue the studies indicated by the name of the class.

The following is the Report embodying the proposed changes in the organization of the University, to which reference is made on page 767. It was at first designed to give in this account of Tulane illustrations of the several buildings of the University, but, in view of the proposed architectural reorganization of the Institution, it is not thought expedient.

REPORT TO THE BOARD OF ADMINISTRATORS OF THE TULANE EDUCATIONAL FUND.*

The Committee on Education, to which was referred the communication of the late lamented President, Hon. R. L. Gibson, on the subject of reorganization of the University, has the honor to report that it approves the wisdom of the general plan recommended by our late President, and advises that it should be accepted as marking out the lines along which the future development of the University should be conducted; but considers that some of the details of organization suggested by him are too complex and elaborate to be adapted to the present means and strength of the University, and that a simpler organization would operate better for the present, leaving the more complex details to be developed with the growth of the institution and under the light of experience.

The committee, however, recommend the adoption of the following Resolutions which embody the dominant principles of President Gibson's plan.

1. The Constitutional contract between the State and this Board of Administrators emphasizes, as its main purpose and object, the duty of this Board to "create and develop a great University in the City of New Orleans;" and in accordance therewith, as well as with the known wishes of Paul Tulane, this Board now recognizes and announces the creation and development of such an University as the proper field and object of its future action.

THE HIGH SCHOOL TO BE DISCONTINUED.

2. Grammar school instruction is not embraced within the functions of an University, and the Tulane High School, which, up to this time, has rendered necessary and invaluable service, should now be discontinued, and, accordingly, the Board announces that the same will be discontinued after the end of the next ensuing

*Tulane University of Louisiana. Report of the Committee on Education, adopted at the meeting of the Board of Administrators of the Tulane Educational Fund. January 9, 1893. New Orleans: L. Graham & Son, 44 and 46 Baronne Street. 1893.

session thereof terminating in June, 1894. After the present session no students will be admitted below the Intermediate grade. Scholarships thereafter granted under the law or by this Board will not entitle the holders to admission below the Intermediate grade. Provision should be made to complete the High School instruction of all students on the rolls in June, 1894, who shall then have successfully passed examinations for admission to the Sub-Freshman Class.

3. In the meantime, the President of the University is requested to devote his attention to a consideration of the best means to secure the establishment of Grammar Schools, Public and Private, in different parts of the city and State, having competent teachers and a uniform course of studies, selected and adapted to prepare students for admission to the Colleges of the University; and to formulate and recommend to the Board such plan for encouraging such Grammar Schools as, after examination, he concludes will be most effective.

THE COLLEGES OF THE UNIVERSITY.

4. The University shall comprise the following Colleges, viz.: 1st, a College of Medicine; 2d, a College of Law; 3d, a College for the higher education of women; 4th, a College of Arts and Sciences; 5th, a College of Technology; and such other colleges as may hereafter be established. The first three Colleges above named shall consist of the existing Medical Department, the Law Department and the H. Sophie Newcomb Memorial College; and, while the Board reserves their existing organizations as subjects for future consideration and action, it is not deemed advisable, for the present, to interfere with them.

5. The present system of instruction and organization of Tulane College shall continue until the end of the session of 1893–94, subject to such modifications as may be deemed proper to prepare the way for the transition to the system provided in the following resolutions.

THE PROPOSED UNDERGRADUATE COLLEGES.

6. There shall be established, to take effect at the commencement of the session of 1894–95, two distinct colleges, viz.: 1st. A College of Arts and Sciences devoted specially to training in the studies appropriate to a liberal education and generally embraced within the Classical, Literary and Scientific courses now in force in Tulane College. 2d. A College of Technology devoted specially to training in the application of science to the Mechanical and other Arts, and, generally, in the studies now embraced within the existing Engineering course, and in others similar and cognate. Each of these colleges shall have a separate faculty and organization, and shall pursue courses of study to be prescribed by the combined Faculty of the two Colleges and the University Faculty proper. Until otherwise ordained the President of the University shall be, *ex officio*, a member and the President of the Faculty of each of said colleges. The same person may be a member of each Faculty, and the students of both Colleges may be grouped in common classes for instruction required in both courses, but, as rapidly as means admit and number of students requires, the distinctness of the two Colleges shall be progressively increased.

THE UNIVERSITY FACULTY.

7. There shall be also a University Faculty proper, over which the President of the University shall preside, composed of members, who may also belong to the College Faculties, engaged in postgraduate instruction which shall furnish instruction to graduates of the Colleges and of other institutions of like grade, in advanced courses to be prescribed by said University Faculty.

NEW BUILDINGS PROPOSED.

8. Steps shall be at once taken to provide necessary and proper buildings and improvements on the grounds opposite Audubon Park, to which the Academical departments of the University should remove as soon as completed and not later than the beginning of the session of 1894–95.

9. Considering the changes now made in the University organization, it is deemed advisable that, instead of the single building heretofore proposed, two separate buildings or groups of buildings should be erected, one for each of the two Colleges above referred to, in which, for the present, University instruction may also be given—reserving for future consideration the erection of such central University buildings and others which may be required.

Other minor buildings for laboratories, and other purposes, may be immediately required.

This whole matter, with all its co-ordinates, is referred to the Special Committee on Building and Grounds already constituted, who are requested, in co-operation with the President of the University and such Committee of the Faculty as he may select, to formulate a general scheme for the laying out of the grounds and the location of buildings, adapted, as far as possible, to present and future requirements, and also to recommend the kind, style, size and accommodations required for the buildings to be immediately erected, which, when approved by the Board, may furnish a guide and basis for further action.

10. The Real Estate Committee, in view of the prospective vacation of the grounds now occupied by the University, is requested to give its constant consideration to the best means of disposing of the same, or of improving it for renting purposes, keeping in mind the necessity of reserving proper accommodations for the Law Department, and perhaps for other University purposes requiring a central location.

Respectfully submitted,

CHAS. E. FENNER,
Chairman Education Committee.

NEW ORLEANS, *January* 9, 1893.

TULANE UNIVERSITY OF LOUISIANA.

BOARD OF ADMINISTRATORS, 1892–93.*

Randall Lee Gibson (U. S. Senator), *President.*
Charles Erasmus Fenner, Associate Justice Supreme Court of Louisiana, *First Vice President.*
James McConnell, *Second Vice President.*

Tobias Gibson Richardson, M. D.	Henry Ginder.
Edward Douglas White (U. S. Senator).	John Timmons Hardie.
Edgar Howard Farrar.	Robert Miller Walmsley.
Benjamin M. Palmer, D.D., LL. D.	Joseph C. Morris.
Samuel Horton Kennedy.	George Quintard Whitney.
Walter Robinson Stauffer.	Leonard Matthews Finley.
Cartwright Eustis.	John B. Levert.

* The decease, during the academical year, of both General Gibson, the President, and Dr. Richardson, a member, made necessary certain changes in the organization of the Board. Justice Fenner, was made President; Mr. McConnell, First Vice President; and U. S. Senator White, Second Vice President. Messrs. Warren S. Bickham, and Walter C. Flower, were chosen as the new members of the Board.

EX-OFFICIO.

Hon. Murphy J. Foster, Governor of Louisiana.
Hon. John Fitzpatrick, Mayor of New Orleans.
Hon. A. D. Lafargue, State Superintendent of Public Education.

OFFICERS.

Wm. Preston Johnston, LL.D., *President of the University.*
Wm. O. Rogers, LL. D., *Secretary of the University.*
Joseph A. Hincks, *Treasurer and Secretary of Board.*
Charles G. Gill, Ph. D., *Librarian.*
Richard K. Bruff, *Assistant Secretary.*

CHAPTER IV.

SPECIAL TECHNICAL TRADE SCHOOLS.

The two schools grouped with the Art Schools of, and, in 1884, under the general supervision of the Trustees of the Metropolitan Museum of Art, in New York City.—The Apprentice School, for Masons and Plumbers, founded by Col. Auchmuty.—The Technical School for Carriage Draftsmen and Mechanics, founded in 1880, by the Carriage Builders' National Association.—Report on the School made by the Committee to the Convention in New Haven, in October, 1883.—The Chatauqua plan of teaching by correspondence, then adopted.—The plan announced and explained by circular of the committee in November, 1883.—Prospectus of School for its fourth year.—Conditions of award of Diplomas and of the Grand Prize of a residence for study in Paris.—The School removes to the rooms in the building of the Young Men's Institute, 222 Bowery, New York.—Prospectus for 1893–94.—The Educational discussion at the National Convention at New Haven, Connecticut, in 1883.—Able report by the Committee on Technical Education.—Discussion on the training given in public schools.

THE TECHNICAL SCHOOLS OF THE METROPOLITAN MUSEUM OF ART.

As stated in the opening paragraph of Chapter VIII, the only schools of this class existing in 1884, were those at that time occupying a part of the rooms used for the Art Schools of the Metropolitan Museum of Fine Arts, and were known as the Technical Schools of the Metropolitan Museum, and the Technical Schools for Carriage Draftsmen and Mechanics. The Art Schools of the Museum were then under the special direction of Professors Goodyear and Stimson. The latter, an enthusiastic artist and art teacher, who thoroughly believes in the application of art to industries, shortly after, having resigned his position in the schools of the Museum, opened the still flourishing "Institute for Art Artisans" where art ideals are cherished.

The practical "Trade Schools," for the teaching of brick laying and plumbing, founded by the efforts of the late Colonel Auchmuty, whose recent decease is mourned by all, were at that time housed in the same building and were, also, included under the general term of the Technical Schools of the Metropolitan Museum of Art. These schools, opened for the training in these practical trades of American boys, shut out from other opportunities to learn trades, through the restrictions imposed by Labor Organizations, were "Apprentice schools," pure and simple, and as they dealt mostly with the mechanical work of the mason, and the plumber, and very little, if at all,

with instruction in drawing, or in any applications of art, are not included in the category of this Report.

The experiment of Colonel Auchmuty was directed to meet a crying need. To admit without restriction, foreigners skilled in trades, to our industries; while suffering our own children to be shut out, by the organizations open to these very foreigners, from any opportunities to acquire such skill, would seem an incredible folly; were it not that it exists. Col. Auchmuty has here furnished one solution of the problem for American communities.

These schools are commended to the examination of all interested in the promotion of American industries, and in the welfare of American boys. Whether our towns and cities, shall contribute "hoodlums," or "artisans," to the body politic, is a vital question. The introduction of Drawing, and Manual Training, in public schools, are elementary steps towards its solution. Special Technical Trade Schools, supplementary to our present system of public schools, and supported by private effort, or by the public, are in logical sequence.

The schools of bricklaying and plumbing, which are still in active operation, were removed after a year or two, from their connection with the Museum schools and established in their own premises.

Technical School for Carriage Draftsmen and Mechanics, New York, N. Y.

This school established by the Carriage Builders' National Association, is held by arrangement with the Trustees of the Metropolitan Museum in connection with the Schools of that Museum, at present, (1884,) occupying the premises No. 214 East Thirty-fourth Street, New York City. It is a special department of the schools and is in charge of a committee on technical education appointed by the Carriage Builders' Association and acting in concert with the Museum Trustees.

This committee, consisting of seven members, was first appointed at the annual convention held in Chicago, in 1880, at which time a fund of several thousand dollars was subscribed for the establishment and support of such a school. The members of this committee were appointed for the term of three years. At New Haven, in 1883, the convention, after receiving and discussing the report of this committee, reappointed them for another term of three years, and contributed a sufficient fund to insure the continuance of the School for that time.

The class was first begun in the winter of 1880-'81, it opened with 21 pupils, and had an average attendance of 16.

The following is the Report of the committee just referred to, which gives an account of the school in detail, for its third year, and incidentally mentions the attendance for the year previous.

THE TECHNICAL SCHOOL.

Mr. McLear (President): The report of the Committee on Technical Education will now be read by Mr. Houghton.

To the Members of the Carriage-Builders' National Association—

Gentlemen: It is with pleasure that your Committee on Technical Education report the successful continuance during the past year of the trade school established and maintained by you, having for its purpose the instruction of carriage draftsmen and mechanics.

This school is still carried on in connection with the trade schools of the Metropolitan Museum of Art, in New York city, forming a special department in that institution, which department is again subdivided into several classes, under the instruction of teachers chosen by your committee.

Its progress since the presentation of our last annual report may be briefly stated as follows:

The third term for the season of 1882–83 opened on the evening of October 9th, 1882, with 28 pupils on the roll, as compared with 26 at the beginning of the second season; and before the close of the term, on May 25 last, this number was increased to 44, as compared with 49 at the close of the preceding season. The pupils were divided among the different mechanical departments as follows: 29 wood-workers, 7 blacksmiths, 1 trimmer, 1 painter, and 6 office men. As to locality, their residences were distributed as follows: New York city, 22; Brooklyn, N. Y., 6; Long Island City, N. Y., 4; Canada, 2; Newburg, N. Y., 1; Westchester Village, N. Y., 1; Portland, Me., 1; Merrimac, Mass., 1; Cornwall, N. Y., 1; New Haven, Conn., 1; Cleveland, O., 1; Wilmington, Del., 1; Pennsylvania, 1; and San Francisco, Cal., 1.

Three sessions per week, namely, each Monday, Wednesday, and Friday, were held during the period beginning October 9, 1882, and closing May 25, 1883, or a total of 94 class nights; and the attendance averaged as follows: During October, 26; November, 26; December, 24: January, 22; February, 25; March, 23; April, 21; and May, 24. Two of the pupils were never once absent. In view of the stormy weather and the long distances which many of the pupils had to come, we can not but think this showing of the average attendance a fair one, though we confidently expect it will be largely increased during the current season.

"Teachers' certificates of progress" were awarded to 24 of the pupils above alluded to, and cash prizes to the amount of $38 were distributed among those showing the best records as to attendance, progress in drawing, and correctness in written examinations.

BEGINNING A NEW SCHOOL YEAR.

The term for the season of 1883–84 was duly opened on Monday evening of last week (October 8), and it is too early yet to do more than forecast the future; but your committee have made ample arrangements for a wide field of study, and there is every prospect that this fourth season will show an increased number of scholars, and give evidences of still more decided progress. Three competent teachers have been employed and are now earnestly engaged in the work, namely: Mr. John D. Gribbon, instructor-in-chief; Mr. John C. Konrad, assistant instructor; and Mr. J. Polya, special instructor in the principles of the "French rule" of carriage drafting and their application to the needs of body-makers; and 32 pupils have already been enrolled, against 28 at the beginning of last term. Most of these are former pupils who will be able to enter advanced classes, and it is hoped and believed that all the classes will be filled as soon as the season fairly opens and the present increased facilities for instruction are understood by the trade.

The course of intsruction—this term, as previously—will depend somewhat on the proficiency and requirements of the pupils, who are divided into three distinct classes, namely, the "introductory class," the "class for body-makers," and the

"class for full-size working drawings;" but the following gives a general outline of the proposed studies: 1, Linear designing, including scale and full-size drawing; 2, geometry applied to carriage construction, including the principles of the "French rule;" 3, carriage-body making; 4, construction of carriage gearings; 5, wheel-making; and 6, principles involved in the suspension of carriages.

The competition for the "grand prize," which will probably be awarded at the close of the present term, promises to make this season unusually interesting, as several of the older pupils have already expressed a determination to prepare themselves for the necessary examination. This "grand prize" consists of a three months' residence in Paris, and tuition during that period in the celebrated Dupont School of Carriage-Drafting, all expenses of such residence, tuition and traveling to be defrayed from a fund specially raised for that purpose at the Cincinnati Convention in 1881.

LECTURES BY SPECIALISTS.

During the winter of 1882–83, as previously, the School was addressed by six specialists, on various practical subjects connected with carriage mechanics. It is proposed to continue the custom this year, and notice is hereby given that any member of the Association feeling competent and willing to give an informal address before the School, on any technical subject connected with carriage-building, will confer a favor by addressing the secretary, stating subject, etc. These lectures are free to pupils, who are expected to attend and to make careful notes, as written examinations generally follow.

Regarding the arrangements which your committee have made with the trustees of the Metropolitan Museum of Art relative to the rent of class-rooms, lighting, heating, &c., that of last season, as detailed in our last annual report, has been renewed for the current year, namely $1,200 in addition to the fees received from pupils ($5 each), which sum also includes the salary of the instructor-in-chief, while the two assistant teachers are paid extra from the school fund contributed by members of your Association.

Your school fund, as will be shown by the report of the treasurer of this committee, though ample for present needs, requires to be increased during the present year, in order that your committee may not only be unembarrassed as to the development of present plans, but may proceed with a feeling of assurance as to the future of the School; and it is hoped that contributions will be made during the present Convention sufficient at least to cover the expenses of the past year.

Your committee also desire to invite contributions to the "technical library," "museum of models," and "collection of carriage drawings," which now form important adjuncts to the working facilities of the School. These collections, if gradually augmented by the gifts of friends and occasional purchases, promise in time to become of great value, not only to the pupils, but to the carriage trade at large. With this end in view, we beg to suggest that any of the models or parts of carriages exhibited by members of this Convention which the members may feel disposed to contribute, will be gratefully received and cared for, upon notice being given to either member of the committee, or to Mr. John D. Gribbon, the instructor of the school.

Respectfully submitted.

Signed by the Committee on Technical Education.

JNO. W. BRITTON, *Chairman*;
WILDER H. PRAY, *Treasurer*,
WM. D. ROGERS,
LOWE EMERSON,
CHAUNCY THOMAS,
WN. N. FITZ-GERALD,
GEO. W. W. HOUGHTON, *Secretary*.

The reading of the report was followed by a statement by the chairman, Mr. Britton, who made an appeal for the continued support of the school and stated further the plans of the committee for extending the usefulness of the school by adopting what is known as the Chautauqua plan. The following brief extract from this discussion explains the plan proposed, for which special purpose the chairman announced that one gentleman, Mr. Lawson Valentine, of New York, had already given one thousand dollars.

Mr. STUDEBAKER: Under the system as now proposed, there will not be a town or city of any importance in the country that will not have many advantages. There is no carriage manufacturer but needs a good draftsman. These can obtain instruction from this school and so improve themselves.

Mr. McLEAR (President): If a draftsman wishes to obtain instruction, he need merely send his drawings on to New York, have them criticized, and returned to him, continuing the matter just as long as he pleases, and with the same result as if he were present at the school.

Mr. BRITTON: The committee believe that what a boy gets for nothing is not appreciated, and we shall probably ask an annual subscription—say $1 for apprentices, $2 for journeymen—for corresponding members. We have not fixed upon that plan yet; but I think that will be the result. If there is any gentleman here who thinks that the instruction should be free, I should be glad to hear from him. But my experience is that things that are got for nothing are not appreciated.

Mr. FITZ-GERALD: I wish to say a word. These lesson papers commence with those of the primary class, working up until the workman becomes a competent draftsman. These drawings that you see here are specimens from the primary charts up to the most elaborate. We take these lessons and distribute them to any scholar whose employer may recommend. He can work on these lessons and send them to us, and our teachers will examine them and return them with such instructions as may be necessary.

In response to the appeal for subscriptions, the sum of $7,210 was then added to the Technical School fund, by individuals and firms; making a grand total of present resources of $11,458.76 of which $500 is a "special deposit for Paris scholarship."

The following "official announcement" inaugurates the new Chautauqua plan by which it is proposed to offer the benefits of the school to every workshop; and to any citizen in the United States who may choose to accept them.

TECHNICAL SCHOOL FOR CARRIAGE DRAFTSMEN AND MECHANICS.

No. 214 EAST 34TH-STREET,
New-York, November 5, 1883.

To the Carriage and Accessory Trades of the United States: Manufacturers, Journeymen, Apprentices and other Employés:

The Committee of the Carriage Builders' National Association on Technical Education, in accordance with the action of the Association at the Convention held in New-Haven, Conn., on the 17th and 18th ult., hereby announce that arrangements have been completed whereby to extend the benefits of instruction offered by the Trade School in New-York, to the employés of all carriage builders and members of the accessory trades, at their homes, by means of the so-called "Chautauqua System," to which your attention is now invited.

This system, in the form in which the Committee propose to adapt it to the needs of the carriage and accessory trades, consists in organizing classes of so-called "Corresponding Pupils," and in giving instruction to such pupils through the mail, by means of Lesson Papers on free-hand, geometrical, scale and working drawings, each Lesson Paper calling for certain responses, which—either in the form of hand drawings or written replies—will afterward be examined and corrected by the instructor at the School. At the same time, pupils will be invited to ask questions concerning any points in the lessons not thoroughly understood, and also concerning any other practical points connected with the trade; and answers to such questions will be returned by mail. Written examinations will also be introduced from time to time, in order to test the progress and proficiency of pupils; and, at the close of each term, diplomas will be awarded to "Corresponding Pupils" who seem to deserve such recognition.

Arrangements have already been perfected to put this plan in operation within the present month, and the the teacher of the School is now engaged in preparing preliminary instructions in the use of drawing instruments, etc., together with several series of Lesson Papers on free-hand drawing and geometry applied to carriage building, which will be in readiness for distribution as soon as classes can be formed.

All employés of manufacturers of carriages, wagons and sleighs, or of the trades accessory thereto, doing business within the United States, are eligible to membership in these classes of "Corresponding Pupils," the only conditions of entrance being, first, a letter from the employer, certifying that the applicant is a proper person to join the class; and second, the remittance by post-office money-order of $1.00 for each apprentice—or $2.00 for journeymen and others,—which sum will cover all fees for instruction during the present term, closing May 1st, 1884. Each pupil will be expected to provide himself with necessary drawing instruments, paper, etc., and to prepay postage on all communications sent to the teacher. Works of reference and text-books will be recommended to pupils who show the need of such help; and, if desired, these, as well as drawing instruments, paper, etc., will be supplied by the teacher at cost price.

One or more Lesson Papers will be mailed to each pupil each week, the series being selected to suit the needs of individuals, and all further directions will be found printed thereon. In applying for membership, pupils are requested to inform the teacher of any previous experience they may have had in drawing or mechanical work, in order that he may assign them to appropriate classes.

All communications and remittances should be sent to Mr. John D. Gribbon, Instructor, No. 214 East 34th street, New-York; and should be accompanied by the full name and address of the writer, and the name and address of his employer.

Carriage builders are specially requested to use their influence in urging any of their employés, showing a desire for such instruction, to join the new "Corresponding Classes" at the earliest possible date, that they may have the benefit of the full course of instruction.

By order of the Executive Committee, acting for the Committee of the Carriage Builders' National Association on Technical Education.

JNO. W. BRITTON, *Chairman.*
WILDER H. PRAY, *Treasurer.*
WM. N. FITZ-GERALD.
GEO. W. W. HOUGHTON, *Secretary.*

P. S.—Plans are projected for connecting the "Technical School for Carriage Draftsmen and Mechanics," with the "Chautauqua University."

The following prospectus contains in detail all information as to the management and course of instruction of the School.—

PROSPECTUS.—TECHNICAL SCHOOL FOR CARRIAGE DRAFTSMEN AND MECHANICS.— FOURTH SEASON: 1883-1884.

The Class in Carriage Drafting and Construction, carried on in connection with the Metropolitan Museum of Art Schools, Nos. 214 and 216 East 34th-street, New-York, under the auspices of the Carriage Builders' National Association, will open for its Fourth Season on Monday, Oct. 8th, 1883, and continue in session from that date until May 1st, 1884, or about seven months.

TEACHERS.

Three competent teachers have been engaged, namely: Mr. John D. Gribbon, Instructor-in-Chief; Mr. John C. Konrad, Assistant-Instructor; and Mr. J. Polya, Special Instructor in the principles of the "French Rule" of Carriage Drafting and their application to the needs of body-makers.

COURSE OF INSTRUCTION.

The Course of Instruction will depend somewhat on the proficiency and requirements of the pupils, who will be divided into three distinct classes, namely: the "Introductory Class," the "Class for Body-makers," and the "Class for Full-size Working Drawings;" but the following gives a general outline of the proposed studies:

I. Linear Designing, including scale and full-size drawing.

II. Geometry applied to Carriage Construction, including the principles of the "French Rule."

III. Carriage Body-making.

IV. Construction of Carriage Gearings.

V. Wheel-making.

VI. Principles involved in the Suspension of Carriages.

FURTHER ADVANTAGES.

Further advantages are offered to pupils in the free use of the Technical Library and Museum of Models connected with the School, and free admission to the usual course of Technical Lectures.

TECHNICAL LECTURES.

The Class, during each previous season, has been addressed by several specialists, on various practical subjects connected with Carriage Mechanics, and it is proposed to continue the custom this year. The lecture programme has not yet been completed, but due notice thereof will be published by circular and through the trade journals. These lectures are free to pupils, who are expected to attend and make careful notes, as written examinations will generally follow the lectures.

Notice is hereby given, that any person feeling competent and willing to give an informal address before the School, on any technical subject connected with Carriage Building, will confer a favor by addressing the Secretary, stating proposed subject, etc.

CERTIFICATES AND PRIZES.

At the close of the season, "Teachers' Certificates of Merit" will be given to pupils passing a satisfactory examination, and prizes (hereafter to be announced) will be awarded to'specially deserving pupils. Full particulars regarding the award of "Diplomas of Graduation," and of the "Grand Prize," the latter consisting of a three-months' residence in Paris and tuition in the Dupont School, at the expense of the Association, will be found appended to this circular.

TERMS.

The following extracts from the Prospectus of the Technical Schools issued by the Trustees of the Metropolitan Museum of Art, contain full particulars regarding terms:

"The Class in Carriage Drafting and Construction, with special reference to Artistic Design and Finish, established under the auspices of the Carriage Builders' National Association, is devoted to the study of Carriage Building, mechanically and artistically. Price of full course, from Monday, Oct. 8th, 1883, to May 1st, 1884, three nights each week, viz.: Monday, Wednesday and Friday, from 7.30 to 10 o'clock, $5.00."

DRAWING INSTRUMENTS.

There will be no charges of any kind, beyond the fee above named, excepting the cost price of any necessary drawing instruments and materials which the pupil does not himself furnish, as named below.

Each draftsman will need, and can obtain at the School, if preferred, a set of drawing instruments (costing from $3.00 to $10.00, according to quality), together with the following appliances (costing about $3.00), namely:

1 drawing board, 18 x 24 in., or 24 x 30 in.
1 plain T-square, 24 in. long.
1 plain wood set square, 6 in., 45 degrees.
1 ditto, 11 in., 30 degrees.
1 stick India ink.
6 drawing pins.
1 piece rubber.
1 piece ink-eraser.
1 pencil No. 4, Faber or Dixon.
1 pencil No. 2, Faber or Dixon.

EMPLOYMENT.

The Committee and Instructors will take pleasure in doing what they can to assist in procuring employment, in New York and immediate vicinity, for pupils from a distance who have already had experience in any branch of carriage-making.

For further particulars, address or apply in person to Mr. John D. Gribbon, Principal of the Carriage Class, either at the School Building, Nos. 214 and 216 East 34th street, or at his residence, No. 312 East 37th st., New York.

By order of the Executive Committee, acting for the Committee of the Carriage Builders' National Association on Technical Education.

JOHN W. BRITTON, *Chairman.*
WILDER H. PRAY, *Treasurer.*
WM. N. FITZ-GERALD.
GEO. W. W. HOUGHTON, *Secretary.*

NEW YORK, *September* 28, 1883.

CONDITIONS GOVERNING THE AWARD OF DIPLOMAS AND OF THE "GRAND PRIZE."

The following conditions shall govern the graduation of pupils of the Class in Carriage Drafting and Construction, now under the control of this Committee of the Carriage Builders' National Association on Technical Education, namely:

First. No pupil will be entitled to receive the full "Diploma of Graduation" until he has been a member of the Class for at least two terms.

Second. He must, upon examination, evince a thorough knowledge of geometry as applied to carriage building, known as the "French Rule of Drafting," show facility in making free-hand drawings, and be able to make scale and full-size working drawings of carriages, together with cant-boards for the same.

Third. A Teacher's "Certificate of Progress" may be awarded to all pupils attending the Class, whose ability and conduct deserve such recognition, and who, for any satisfactory reason, are prevented from pursuing the full course of instruction.

Fourth. The "Grand Prize," consisting of a three months' residence in Paris, and tuition during that period in the school of Mr. Albert Dupont,—all expenses for such residence, tuition and traveling to be defrayed from a special fund raised for that purpose by the Carriage Builders' National Association at the Convention in Cincinnati,—will be awarded to the pupil who graduates with the highest honors in the Class of 1884, receiving the full "Diploma of Graduation," and who, at the same time, answers the following conditions, and complies with the following stipulations, namely:

1st. In order to be eligible as a competitor for the "Grand Prize," the graduate must have attained the age of twenty-one years, and he must be able to read French with facility, and to converse in that language; and he must know the French equivalents of English technical terms used in carriage making.

2d. During his residence in Paris, the pupil receiving the "Grand Prize" will be required at stated periods to make written reports to the instructor of the class in New-York regarding his progress; and he will also be required to attend the class in New-York during the term following his residence in Paris, and to act during that term in the capacity of an assistant instructor, without pay, and communicate to the pupils the results of the technical instruction received by him while abroad.

3d. The Committee reserve the right to postpone the award of the "Grand Prize" in case no pupil should, in their judgment, exhibit the necessary qualifications at the examination to be held at the close of the season of 1883–84; and the Committee also reserve the right to consider the claims of competitors under twenty-one years of age, providing no contract of apprenticeship acts as a bar.

By order of the Committee of the Carriage Builders' National Association, according to resolution adopted at a meeting of the Executive Committee, held in New-York on Dec. 8th, 1881.

JOHN W. BRITTON, *Chairman.*
WILDER H. PRAY, *Treasurer.*
WM. N. FITZ-GERALD.
GEO. W. W. HOUGHTON, *Secretary.*

The first term of the School ending December 1, 1883, showed an attendance of 36, with 76 "corresponding students." The end of the second term, May 31, 1884, showed an attendance of 39, and a list of 169 "corresponding students," which seems very like a practical demonstration of the wisdom of the adoption of the "Chautauqua Plan."

The members of the Committee on the School for 1883–'84, were, on the part of the Metropolitan Museum, John Taylor Johnston, President; William L. Andrews, Robert Hoe, Jr.

On the part of the Carriage Builders' Association, S. W. Pinchot, Jno. W. Britton, V. G. Stiepevich, W. C. Tuckerman, S. W. Kitson. Sub.committee in charge, Robert Hoe, Jr., W. C. Tuckerman.

THE SCHOOL NO LONGER UNDER CARE OF THE METROPOLITAN MUSEUM.

In the summer of 1885, the Technical School, no longer connected with the Metropolitan Museum, removed to the fine building of the Young Mens Christian Association, known as the "Bowery Building," the home of the Young Mens Institute, Nos 222 & 224 Bowery, New York City, where it still remains. I am indebted to the courtesy of the Hon. Franklin Murphy, Chairman of the Executive Committee in charge of the School, and of the Principal, Mr. Andrew F. Johnson, for information as to the history of the school since 1884, and for the prospectus for the season of 1893–1894. Mr. Murphy states that "The work has gone on very much as it did in Mr. Britton's time and the attendance in the school upon the average is about the same, say thirty, most of whom are carriage mechanics in New York, who attend the school for the purpose of learning carriage drawing. The corresponding class has always been well maintained. I think you are aware of the fact that the school is conducted under the auspices of the National Carriage Builders Association of which Mr. Britton was the Founder." Mr. Jno. W. Britton, whose ardent interest in the school appears in the extracts which follow from the report of the discussion during the convention in New Haven in 1883, deceased some years since; and is succeeded in the Chairmanship of the Executive Committee in charge of the School, by Mr. Murphy.

In February 1892, the Instructor, Mr. John D. Gribbon, died. Mr. Gribbon, had been the Instructor in Charge of the School from its opening in 1880. Mr. Andrew F. Johnson, his successor was a member of the first graduating class in April 1885, and the winner of the "Grand Prize." The course of instruction of the Evening classes remains substantially as given in the prospectus for 1883–84.— The following, from the official announcement of the "Prospectus: thirteenth season, 1893–94." gives, in detail, the course of instruction for the "Corresponding Classes."

CORRESPONDING CLASSES.—MANAGED ON THE CHAUTAUQUA SYSTEM.

Instructor, Mr. ANDREW F. JOHNSON.

Instruction will also be given by correspondence to employees of carriage-builders and members of the accessory trades, at their homes, by means of the so-called "Chautauqua System."

This system consists in giving instruction to out-of-town pupils through the mail, by Lesson Paper, on making free-hand, geometrical, scale and working drawings,

each paper calling for responses in the form of hand drawings or written replies,—which are afterwards examined and corrected by the instructor, Mr. Andrew F. Johnson.

Three terms are required in order to complete the full series of Corresponding Lessons, which are eighty-three (83) in number, as follows:

First Series.—Free-hand drawing. Lessons, 11.

Second Series.—The use of mathematical instruments and curves, the mode of sketching a carriage. Lessons, 10.

Third Series.—Geometry applied to carriage construction; projection of points, lines, and surfaces; laying out working draft of a phaeton body, and generation of surfaces illustrated on a phaeton. Lessons, 8.

Fourth Series.—Movements of triangles and lines in space; rules applicable to plane faces illustrated on a trestle, a phaeton pillar, a cabriolet pillar and bottom-side of a landau, showing the method of finding the true size and shape of a pattern, and the bevel of shoulders of the Cross-bars. Lessons, 13.

Fifth Series.—On finding the dihedral angle, or, in workshop parlance, finding the bevel of the leg of a trestle, phaeton pillar, cabriolet pillar, and landau bottom-sides. Lessons, 6.

Sixth Series.—On the choice and disposition of joints. Lessons, 3.

Seventh Series.—General dimensions applicable to vehicles, and laying out working drawings of a phaeton body and gearing. Lessons, 3.

Eighth Series.—Laying out square and round-cornered stick seats, and round-paneled seats; generation of double curved surfaces, illustrated by a barouche with round bottomsides, including the study of different forms of bodies, such as drop-centre landaus, and broughams with ogee turn under; ogee front quarter, bottom-sides of coaches and barouches; cheat-line, and proportional triangle illustrated on a Clarence body and on a C-pillar back quarter. Lessons, 24.

Extra Series.—The draught of vehicles and division of weight, displacement of centre of gravity, and objectionable mode of suspension. Lessons, 4. Miscellaneous subjects. New method of determining the cheat-line. Lessons, 1.

On the receipt of Tuiton fee, all lesson papers for the term will be mailed to the pupil at once, instead of one each week as heretofore, in order that the pupil can see to what the lessons are tending, and any pupil who has finished the study of the full term lessons will, by sending tuition fee for the next term to the Instructor, receive the whole number of lessons for that term.

This class will hereafter be kept open during the entire year, and pupils may join at any time.

There are twenty-nine lesson papers in first term; twenty-five lesson papers in second term; and twenty-nine lesson papers in third term.

Pupils in this class are also invited to ask questions concerning practical points connected with the trade, and answers to such questions will be returned by mail. Written examinations will be required at the end of each series of lessons, in order to test the progress and proficiency of pupils; and, at the close of the term, diplomas will be awarded to those deserving such recognition.

The primary class will be occupied chiefly with the study of free-hand drawing, which the Committee deem of foremost and vital importance to all mechanics; the "Intermediate Class" and "Advanced Class," for the study of carriage geometry as applied to carriage construction, popularly known as the "French Rule."

All employees of manufacturers of carriages, wagons and sleighs, and the trades accessory thereto, doing business within the United States and Canada, are eligible to membership in these classes of "Corresponding Pupils," the only conditions of entrance being: first, a letter of recommendation from the employer; and second, the remittance in advance, by post-office money order, of $1 for each apprentice

under twenty-one years of age,—or $2 for journeymen and others—which will cover all fees for instruction during the first term.

Each pupil will be expected to provide himself with necessary drawing instruments, paper, etc., and to prepay postage on all communications sent to the teacher.

Works of reference and text-books will be recommended to pupils who show the need of such help; and, if desired, these, as well as drawing instruments, paper, etc., will be supplied at cost price by the teacher.

These lessons are also peculiarly well fitted for stair-builders, ship-builders and mechanics in general who have to do with the more complicated forms of work, although only persons employed in carriage building are admitted to the classes.

By order of the School Committee, acting for the full Board of School Trustees representing the Carriage Builders' National Association.

FRANKLIN MURPHY, *Chairman.*
W. W. OGDEN,
C. M. BRITTON,
HENRY MORTON, Ph. D.
E. M. HOTCHKISS, *Sec'y and Treas.*

There have been ten "graduates" since the first class in 1885, and each of these are said to be filling responsible and well paying positions or are in business for themselves. Three hundred and fifty pupils have attended the Evening Class since its opening in 1880, and seven hundred and thirty two have joined the corresponding class. These were from twenty nine States, two territories, and Mexico, and Canada. Andrew F. Johnson is the Instructor in Chief No. 222 Bowery New York.

EDUCATIONAL DISCUSSION AT ANNUAL CONVENTION, 1883.

In connection with the account of the establishment and support of this technical school the further action of the Carriage Builders' National Association, in regard to questions of education, is not without interest. The public discussion in 1883, by the convention at New Haven, which followed the reading of a report upon "apprenticeship," embraced many of the topics already considered in this Report. As the views of practical men, from various sections of the country, they are full of interest and of suggestion;—some quotations from their remarks are here inserted, as bearing directly upon the question of how far the training in the elementary public schools can be made to promote technical proficiency in the industrial arts. The question of possible apprenticeship has an important bearing upon a consideration as to what changes are desirable, or additions feasible, in the present system of public schools.

In the discussion which followed the reading of the report, many degrees of intelligence were evinced as to what is already taught in the schools, and as to what it is desirable to teach in order to best prepare pupils for acquiring a knowledge of the art of carriage building; together with much indiscriminate complaint of the public schools. If, as some of the speakers contended, the best age, for

boys to begin apprenticeship to this trade is that of 15 years, it is obviously unreasonable to demand of the schools as much of training as if the boys remained in school till 18 years of age,—some of the speakers recognized this, others did not;—some affirmed that in some public schools, instancing them, good preparation for the industrial arts was given and argued that similar training could be given in all; others recognized that educational training must be carried on long beyond the 15th year, and urged provision for that by the employers; all, however much they might differ as to details, were agreed that the only way to keep the art of carriage building in this country from deteriorating, was to be attained by affording to the future workmen the means of acquiring superior mechanical and technical training.

REPORT BY THE COMMITTEE ON APPRENTICESHIP.

The association, at its previous annual meeting, had "appointed a committee to enquire into the present condition of the apprenticeship system of the carriage trade in various parts of the United States, and to recommend, if possible, some plan which might be generally adopted by the carriage builders of the country." Mr. Jno. W. Britton, of New York, Chairman, and Messrs. Wm. D. Rogers, of Philadelphia, Penna., and Chauncey Thomas, of Boston, Mass., constituted this committee. In their long and well written report, the committee recite their actions and comment at length upon the situation. They issued inquiries to the trade generally but received few returns. In commenting on the apparent indifference to a matter of such real concern they say:

The builder of medium and high grades of carriages must be aware that this indifference as to where the skilled labor of the future is to come from, is lowering the status and importance of his trade. Machinery will not do all things in the production of carriages of the higher grades; there is a limit to its efficiency in any departments, and it is still an open question whether hand labor or machinery produces under certain circumstances the best work. This remains an open question, not because the well-constructed machine is less accurate than the human hand and eye, but because, as the advocates of hand labor assert, the rapidity of the machine renders it impossible to discover defects in timber and metals which the eye of the well-trained mechanic discovers in the careful and slower handling of the material; hence it may be safely assumed that the demand for skilled mechanics in the production of all grades of carriages will be continued for many generations.

They attribute the absence of antagonisms between laborers and employers in their trade, to the superior intelligence of the workmen.—In passing, they thus refer to the fact that the old system of apprenticeship known to the law has become obsolete, though often, the laws remain on the statute books.—

In the correspondence elicited by our circular letter addressed to the trade, we learn that in many of the States the old Statutes governing the relations between master

and apprentice still remain, but that they have become in the majority of States obsolete. Why this is so, may be accounted for by the fact that they have ceased to have any affinity with modern ideas regarding the interference of the State with individual business and private contract, and the experience of your committee prompts it to sympathize with this view in the matter.

Whatever may have been the necessity or the success of this method in the early days of the nation, and under a government not wholly divorced from the traditional idea that it must in some way share the parental authority with the citizen in its administration of affairs, it would seem unwise under existing circumstances to call upon the State to enact special laws to govern apprentices; but let them be governed as all other citizens are governed as to their duties and conduct, and leave them and their employers to settle upon the terms defining their mutual relations.

NEED FOR ELEMENTARY TECHNICAL TRAINING OF BOYS.

They then enter upon the whole matter of the education of boys for trades, as follows:

The question of technical education in preparing boys for the higher mechanical trades has received a vast amount of attention within the last few years. Your committee believe, however, that in the discussion which it has produced, and which seems to be constantly increasing, we are in danger of losing sight of the practical, and are verging upon theories and schemes which, if not checked, will lead to disaster, rather than success.

There can be no doubt, your committee believe, that there is a real and pronounced want now existing for a higher grade of mechanical education—one which will afford opportunities for instruction to a large number of boys who have a special talent for the higher mechanics, but who without such opportunities would enter into professions and occupations for which they may be totally unfitted; but the country is rapidly supplying this want, and already schools have been established, and have attained a degree of success which warrants us in believing that they will increase as fast as the needs of the country demand. From these schools the manufacturer who has to deal with the higher sciences receives his manager and specialist, whose investigations and experiments enable him to keep pace with competitors and older countries with whom he has to share the trade of the world.

Beyond this brief mention, your committee believe that such schools as have been described need not be considered in discussing this question. A certain amount of technical education has become a necessity to those who are now in the employ of the carriage-builder in this country, and your Association is now striving in a modest way to supply the needs of the trade in this direction, by giving such practical and theoretical instruction in their own school in the city of New York as will enable the young and ambitious mechanic and apprentice to make good the deficiencies of his earlier education.

THE PUBLIC SCHOOLS CRITICISED.

Much of this want in our own country is caused by the inefficient education of the youth in our public schools. These schools are established and paid for by taxation, in order that a fair common education may be secured by the poorest boy to aid in making him an intelligent and useful citizen. Since the earliest days of our Government, this has been considered as a duty of the State, and much of the success achieved by the nation may be credited to this policy; but your committee have evidence that the character of these schools is constantly deteriorating, especially in the larger cities and towns, where the common enemy, party politics, has

sapped their foundations and largely destroyed their usefulness. To-day, the boy under the age of 15 who leaves the average common school finds himself totally unprepared to enter upon a useful career. The studies which would fit a boy for an apprenticeship in some mechanical trade have either been ignored in the school where he has spent several years, or they have been pursued in a manner so slovenly, and under incompetent or uninterested teachers, that they give him little or no help when he enters practical life.

CIRCULAR LETTER ADDRESSED TO PUBLIC SCHOOL OFFICIALS.

Your executive committee during the past year have had under serious consideration the question of public education in connection with the apprenticeship question, and a special committee was appointed, consisting of members of its body, to endeavor to awaken interest in the subject among the educators and official bodies in charge of public education. To this end the following circular was prepared, and a large number of copies were addressed to parties who should be specially interested in the question.

To Officials and Official Bodies in the United States having the Supervision of Public Education:

The Carriage Builders' National Association of the United States, in behalf of the industry represented by them, and of other mechanical industries of our country, beg leave to call your attention to the necessity of some change in the course of study in our public schools, that will prepare those who intend to become apprentices in trades and mechanical pursuits requiring a high standard of taste and skill.

This association, having recently established in New York City a school for the advancement of technical knowledge among the apprentices and young mechanics of our trade, have at the outset been met with the serious obstacle that very few of the pupils, although they may have attended the public schools of this and other cities, have had any instruction in free-hand drawing and geometry so necessary to all who wish to engage in the higher mechanical pursuits.

We are well aware that the studies above referred to are included in the ordinary school course of the cities and towns, but we beg leave to call your attention to the fact that boys intending to learn trades leave school earlier than those intending to follow the professions and other pursuits, and usually before reaching that part of the school course in which free-hand drawing and geometry are taught. Thus they are deprived of the very studies which they specially need to make them skilled and intelligent mechanics.

Your attention is further called to the fact that the advance already made in the mechanical arts in this country calls for a higher standard of taste and skill than heretofore, and there is every evidence that a still greater demand for skilled workmen will arise from year to year in order that in our rapidly increasing production we may successfully compete in the markets of the world with the manufacturers of other countries. At present we are dependent in a great measure upon artisans educated in their trades abroad; but the number of this class seeking our shores for employment is lessening every year, and has almost entirely ceased in many of the trades calling for the highest skill. The lack, too, of any well established apprenticeship system in this country precludes any relief in the near future from that source.

We, therefore, deem it highly important to reinforce the ranks of the mechanics by a system of public school education which shall earlier fit boys to enter into

trades, and with some assurance that their preparatory studies are likely to assist in making them intelligent and skilled workmen.

(Signed) WILLIAM D. ROGERS, Pennsylvania.
CHAUNCEY THOMAS, Massachusetts.
LOWE EMERSON, Ohio.
W. N. FITZ-GERALD, New Jersey.
WILDER H. PRAY, New York.
GEO. W. W. HOUGHTON, New York.
JOHN W. BRITTON, *Chairman*,
1581 Broadway, New York City.

Committee of the Carriage Builders' National Association on Technical Education. March, 1883.

* * * Your committee adopt the views of the executive committee as set forth in their circular, and reiterate that one of the chief obstacles in the way of a good apprenticeship system is the inefficient education, at least in certain branches, of the boys who desire to become mechanics. We who take these badly-educated boys into our workshops know the difficulty to be overcome in making them useful and skilful in their work. A boy who enters a wood-shop or smith-shop with a fair amount of instruction in the branches alluded to in the executive committee's circular, has a decided advantage over one who has been deprived of such instruction, and is more likely to become profitable to his employer and to himself.

It is also believed by your committee that the complaint on the part of employers that apprentices are unprofitable, arises in part from the careless manner in which they are are selected. The selection of a boy because of a robust physique is too often a leading consideration; whereas a boy should be selected, for certain branches at least, because of his mental powers, and his ability to learn and understand what may be considered the higher mechanical requirements of the trade. "Main strength" will not accomplish all things, and the lad who is able to exercise that quality alone should not be asked to learn a trade in which his mental powers as well as his muscle must be brought into his work. There is always a place for a boy who has strong arms and an ill-furnished head, but his place is not at the bench of a mechanic.

It should also be understood that after the employer has exercised his best judgment in the selection of an apprentice his part of the work is still incomplete. How many employers seriously consider the duty they owe to the apprentices they have taken into their shop? If the boy is expected to be industrious and faithful in his work, is there not a reciprocal duty on the part of the master? Is it not his duty to make some effort to put the boy in the right place, and to authorize some competent person to give him the proper instruction, and to see personally that this duty is performed? The boy who comes into the shop to learn a trade and do his duty, is entitled, to use a homely expression, to a "good start," and in addition to that he should have in his progress a part of the watchful care which the employer or his representative gives to the general business. To this should be added some encouragement for duty well performed, without which youths in all stations of life are apt to lose interest in the work before them."

In conclusion they make four recommendations as to the kind of mutual agreements and obligations to be entered into between parent and boy, on the one hand; and employers, on the other, and suggest the appointment of a special committee to prepare legal blanks, etc.

THE REPORT DISCUSSED.

The report, which was evidently well received as an able paper, was then discussed at length; a few extracts follow.

Mr. Britton on the general subject of educating boys said, among other things:

Mr. BRITTON: I do not propose to let this thing stop. I have looked at this thing for a good many years, and I am deeply interested in it. Since I have had something to do with the management of the Technical School, I have learned more about boys; and I tell you boys are deteriorating as well as men. To-day one of the serious wants of the carriage manufacturer is to get a boy who is willing to learn a trade and to have brains. It is almost an impossibility for us in the city of New York to get a boy to learn a mechanical trade after he has come to his seventeenth year. If you get one or negotiate for one, his mother comes there and wants to know if you cannot make an exception in James' case; it is impossible to get up and get his breakfast at seven o'clock; can't you make it half-past seven? That is the mother who is breeding boys who make very poor mechanics. [Applause.] I tell you this subject wants constant agitation. The best plans that have been designed will not hold water, unless there has been public opinion brought upon them to make boys better. [Applause.] If you get pretty good boys, you will have pretty good men. This is a fact; there is no gainsaying it. And we all want that our boys should become pretty good men. This country has become demoralized. I remember 20 years ago people saying: "When the boys come back from the war, what are we going to do with them? They will all be demoralized." A good many people had double locks put on their front doors; but the fact was that the average American boy that went to the war was not the boy to become demoralized. What this country needs more than anything else, is discipline; and that they got there. And when they came back they were better than when they went away. [Applause.] The people who were demoralized were those who stayed at home and got substitutes and got contracts.

* * * I am trying to get at this thing, so that the children of the men who are working for their living and trying to found a respectable business for their successors or their children, may not look at the men who possess millions for examples, but that they must look at men like those before us to-day—that we must take our boys and make them better. We cannot reform the world; but we can do something by working ten hours a day. We can make some one thing better: and I think the place to begin for this Association is the Apprenticeship System. And when you go back and review the proceedings of this Convention I desire that you may have more perfect views on this subject. I left the public schools at 12 years of age. I gave my only boy three years longer than I had, and when I examined him I was sorry to find how little he did know—not as much at 15 as I, and yet a brighter boy than I, a much duller boy, knew at 12. There must be something wrong in this manner of educating. Our present education is not practical and of no earthly use, or else the people that have it in charge do not know their business and we are not doing our duties in not informing them. I can remember when it was a very important thing for a father to look after the education of his boys and girls. If I had time, I should like to have a hack at the girls. We bring them up wrong, too; we do not teach them to sew as skilfully as we teach them to play the piano.

I hope that the suggestions that I have thrown out, and that have been thrown out by others, will help us in determining this matter; and at the proper time I shall make the motion, or ask some one to do so, that we shall go on and perfect this paper; and within a few months—I hope before the year expires—we may be

able to send a perfected plan, not only to carriage-makers, but to other trades, and in that way awaken an interest throughout the land on the subject of apprenticeship. Let us try, and do our duty.

Mr. Thomas, of Boston, also a member of the committee, has his say about the schools, as follows:

Mr. THOMAS: I wish to say in regard to the public schools that I believe the tendency is in the wrong direction. I believe that our principal schools are educating boys not in what they should know, but rather in what they do not need to know. I know that the old institutions still stick to their own literary courses. And perhaps it is well enough. But in my opinion the schools should introduce free-hand drawing and geometry, and also a large amount of practical mechanical knowledge. And the number of such schools is increasing very largely. They have the opposition of the schoolmen who believe in nothing but the old regimen. But still practical men will have their influence, and we will have ours in promoting proper education. I think the outlook is rather hopeful than otherwise.

Mr. KILLAM: I have been very much interested in reading this report. I think it is a very important paper. We cannot over-estimate the necessity of the Apprenticeship System. We must have skilled labor in order to make good work, and our skilled labor must begin at the boys. * * *

Mr. MULHOLLAND: I do not intend to let the matter rest here. My friend says that the schools are taking up the matter to some extent, not as they should, not as we want them to; but they are beginning to teach free-hand drawing and geometry with the younger pupils at school—those that are compelled to leave before probably the age of 15 years to learn a trade. As the chairman of this committee says, it should be the great object of our common schools to make better citizens, to make the masses better, and if the masses require one thing more than anything else it is making better workmen of them, better artisans, better mechanics. * * *

Mr. Maris, then raised a question about the profit or economy of employing boys at all.

Mr. BRITTON in reply said: "There is no question about it that boys pay. We have about fifty of them, some very good ones, and we have found them very profitable. In the trimming shop, for instance, we have a man who knows how to turn a boy into a man, looks after him, takes an interest in him, teaches him; and from the very first day they go there and make their first bucket of paste he makes them pay. He knows what a boy can do and what he cannot do.

The hardest thing in my opinion is to make a first-rate blacksmith out of the average boy, and it is often not a very profitable undertaking. That is the only branch which I cannot say has been a profitable one. But, I tell you, you have no wagon shop until you have a good blacksmith, and the blacksmith boy is the boy that should be of the highest rank, of the very best stock; not only of good physique, but also with lots of brain. For the blacksmith works with his eye and his brain more than a man in any other branch of our trade. And I hope the time will come when every member of this Association that runs a carriage shop will look out to get an exceedingly bright and intelligent boy to put at the forge. Good blacksmiths can be made. We have made them. They are hard to make, and I am afraid they are not profitable; but somebody who has the welfare of the trade at heart must make a few as he goes along.

Mr. SHEPARD: I believe this question, what the future artisans of the country are to be, is one of the most important for the political economist to consider. And in our treatment of the question we must do by the boys as we do by the timber that we put in the carriage. We must first select that which is suitable, and then mould it to the very place we wish it to occupy. So I believe that we should

commence in our common schools of education, and demand of the parents who send children there at their entrance: "What do you wish your boy to become?" If he is to become an artisan, his whole teaching should be to fit him for that very place. The idea of becoming an artisan should be instilled into his mind when he enters school, and all his training should fit him for that very place. [Applause.]

Mr. QUINBY: On the question will boys pay, I would say that we have with us in our manufactory in Newark one man who came with us when a boy, and has stayed 53 years, and another who has stayed 40 years. We find the best mechanics to be the men who have learned their trade with us and have stayed with us ever since." * * *

"Mr. STUDEBAKER, (of South Bend Indiana:) I am satisfied that the place to commence is where the chairman has stated—in the boys when they are young or at home. Try to educate the mothers to instill into the minds of their boys the fact that a mechanical trade is honorable. The great trouble is that the opposite opinion prevails. There is not a day when we are not asked the question: "Can you give my boy a place in your office?" And I frequently ask them: "Why don't you let him become a blacksmith?"

Mr. BRITTON: If he knows enough.

Mr. STUDEBAKER: Of course, there are different branches of our trade. Some do not require as much brains as others. There is a place for all the boys, and to make them successes in life you must start them right, try to mould their characters right, educate them right, make them believe it is honorable to earn their bread by the sweat of their brow. This apprenticeship question is one that has interested me very much, because I had a little experience of it in my boyhood days. In those days a boy had to work, and sometimes would not even get his board, but had to pay something besides. Now the trouble is they want wages right off. But the boys are not so much to be blamed as the parents. What we want is united work, and I see no reason why good results should not come from our efforts. I am satisfied there will. In our establishment we have for over 20 years always taken boys on trial. Time alone will tell what kind of work he can do. One kind of work he will be able to do better than another.

The people of this country are to-day thinking more on this subject of apprenticeship than we have any idea of. We have plenty of politicians and professional men, but we want more business mechanics—intelligent mechanics. There is no reason why a boy's education should not be mechanical. I have been sending my son to college, and as soon as he graduates I am going to put him in the factory, and keep him there until he is a mechanic, if it takes ten years. [Applause.] If the mothers and the fathers of this country would commence with their children when they are young, and press the thought upon their minds that it is honorable to become a mechanic, it will be a great help in this matter. A man does not need to be a shoemaker or blacksmith; some men have succeeded in other lines; but I believe it is more honorable to be a mechanic than anything else. A trade is something that nobody can take from you, no stock-jobbing can rob you of; and therefore I heartily endorse the report of the committee, and hope something will grow out of it that will be beneficial to this Association.

Mr. JUDKINS: I have just a word to say. I am not a talking member. But in regard to this matter I wish to say that I have had a boy in the Technical School in New York since last year; and I know something about how a boy should be fitted to enter a school of that kind. I have learned that the great trouble lies in our common schools and in our advanced schools. I believe that every carriage-maker in New England is blind to his interests, to the interest of his boys and the rising generation, and to that of carriage manufacturing, if he fails to see that the primary and fundamental principle lies in our public schools and seeks to remedy it. It should be obligatory upon every school commissioner and those that manage

schools to see to it that no boy graduates from that school, unless he understands the higher mathematics, the principles of geometry. For if he understands them he can readily learn the mechanical principles of carriage-making. I believe in this, and I believe it is our duty as carriage-makers, and those that love the carriage interests, and love our boys, and love the best welfare of the craft that we represent here, that we should exert our influence in this particular direction, because this is the fundamental principle that boys should know or understand and learn in the primary schools. There are many boys sent to that Technical School in New York who are not fit to enter because they do not understand the higher mathematics. I know a boy in my town who graduated from the high school, yet could not tell the amount of wood in a certain pile. And I believe this is a fair sample of very many of the boys from other high schools. It is ridiculous—a shame; and it all lies with the managers of the schools. In reference to the School at New York, I wish to say that I am very well pleased with it. I was very particular before my boy entered to have him fitted to pass the examination, and I think he passed a very fair examination. His progress has been excellent, not due so much perhaps to his own ability as to the instruction and good management of those who are in charge of the School. [Applause.]

MR. JONES. Mr. Studebaker has said a great many things that I was on the point of saying. I want merely to ask the question are we not educating our boys full enough? Are they not educated to-day in the common schools and the high schools above the capacity of a great many of them? They are educated above work; they all want a position in an office after they get this education. My idea of a technical education or any education is a practical education—an education where a boy can be put to work, taught how to work, and be made to love the work, so that he would become interested in it. The Stevens Institute of Technology in Hoboken is such a practical school. There is another in Worcester, and elsewhere. In these schools a boy learns the use of tools, and thus gets a practical education which I think is worth more than theoretical educations generally. If you get too much theory into a boy's brain, his physical condition cannot work it out—or won't, as is generally the case. It is said a great many men are educated for the ministry because they are not fit for anything else. So they make second-rate preachers that would not be good for anything as apprentices. The gentleman in my rear said a scholar ought to know when he goes into a school just what he is going to do, and that the parents should tell the teacher what that scholar is to do. I think the teacher had better find out what that scholar *can* do. There are but few of them that know as much as that, but occasionally you find one that does. I have a boy in my office who wanted to go to West Point, and asked me about it. I told him: "No, don't throw yourself away on any such tomfoolery as that." He had too much brains [Laughter.] I know that boy will make a business man, and a smart one. If you can only make the boys understand that what they should be is something where they can make themselves useful, and not where they will be a mere ornament to society, and if you can make them think so, they will take hold with a better will, I think.

Mr. COLYER: I have something to add. My experience with apprentices is that the difficulty is to get them to stay when you have them. I have been in the habit of paying them a certain amount for the first six months, and increasing it afterwards by a certain amount, as they showed themselves capable of earning more. But if they can get a little more somewhere else I find them always ready to go away." * * *

Mr. MCLEAR (President): I can say that the system which this committee has outlined by some strange chance—I am not one of the committee—is almost the identical system we have pursued in our factory for 20 years. The only difference is we do not give a diploma and do not increase the pay at the expiration of the

time of service. And in our experience of 20 years we have found it generally to work well, up to the time when the carriage trade was a little demoralized by the panic. We had trouble then because the trade was not so brisk, but since that time we have pursued the same system. We pay our boys, take them for a stipulated period, increase their pay each year, until the last year of the service they get fair wages, five or six dollars a week, and we never have trouble in keeping a boy that we wanted to keep, as far back as I can recollect.

We take care, first in selecting our boys. We try to get them of good parentage, and take them on probation for four weeks or even as long as three months, until we are sure that the boy will make a mechanic. For not all boys do make mechanics. * * *

Mr. ROLPH: I am a mechanic and served my apprenticeship in 1844, and put out my sign in 1849. In my factory, the foreman served his time as an apprentice, 40 or 50 years ago, and has been with me ever since I had charge of the factory, until up to July last, when he died. There is not a man working in that factory since I have had charge of it that did not learn his trade there. I was associated for several years with a nephew of Peter Cooper in the manufacture of glue in Cincinnati.

Mr. BRITTON: That is the reason your men stick so.

Mr. ROLPH: The reason I mention this is the fact that we all know there is a desire to shift the matter of taking apprentices by saying: "Let some one else take them."

Cooper & Co. educated all their glue-makers; and where do they stand to-day? Do we not all know? At the head, and for 40 years have done so. You do not see any of their salesmen begging for trade, as do others in every branch of business. No, you never see a salesman from Peter Cooper's concern, the largest in the world. Why? Because the excellence of his goods makes them go everywhere, and you are begging for them. The report of the committee I am heartily in favor of in every respect.

THE PUBLIC SCHOOLS INADEQUATE.

In regard to the public schools, I do not believe you will get very much beyond what you have already accomplished. I have some experience in that matter, being a public-school officer myself. I do not expect any change in that particular. You cannot expect it. It must come from the technical schools, like the Cooper Institute, and then the public schools will take it up. The boy who is to learn a trade comes to me when he is very young; he has only had an opportunity to go through with the ordinary course in public school. And therefore I am heartily in favor of the report, hope it will be adopted and carried out, and that this diploma system will also be carried out. When I learned my trade, I was to receive $5 a year for spending money, and my board and clothes, and when through I was to receive $50. I have always been thankful that my father signed the indenture to make me an apprentice, and taught me so much that has been valuable. In taking apprentices, I try to see the parents before the boy comes, and if he seems to be a bright, smart boy, of good habits and steady, I engage him. So with my other employes. I took my book-keeper from the public school, and I had occasion to let him go and take another also from the public schools. I never had a boy in my shop or in my office in the 30 years I have been in business, who left me, unless I sent him away or gave him permission to go.

Mr. BRITTON: I am very much gratified with the remarks of the gentleman who has just taken his seat. I do not know that we can get a stronger endorsement of what we are trying to do. But he has not touched the foundation. He says you can not get anything out of the public schools. He is a public school officer—and with due apology—I did not suppose any of the carriage-makers would arrive at that dignity. [Applause.] He says you cannot get anything out of the public schools. You can get a great deal better things out of them than heretofore.

THE PUBLIC SCHOOL AT COLLEGE POINT PRAISED.

When *we* wish a first-class boy, we draw upon the public school of College Point, Long Island. Why do we go there? The German system is in vogue there, and we have four or five boys to-day in our drawing-room that are better educated at 14 than when we take them out of our own New York public schools at 16 years. There is a discipline and method, earnestness and honesty of purpose on the part of teachers in the management of the schools there. The public school at Greenpoint has a class-room called a mechanical class-room, and every boy has a little hack at that every day. When he comes there, he sees a blackboard with lines drawn on it and he learns to calculate; and that is what a Yankee used to do, but he has lost his grip. He don't calculate; he runs head first. [Applause.] Why should the little town of College Point, Long Island, turn out better boys than the great city of New York? Simply because of its better methods and better management. I approve, too, of the German kindergarten method. I wish to say to you that technical schools as we conduct ours have a different object from such schools as the Stevens Institute of Technology at Hoboken. They try to educate leaders. We do not educate leaders; but what we want is to educate men who are to do ordinary work, and to do that work well and intelligently—to render our boys better prepared for the work-shop.

SCHOOLS OF COLUMBUS, OHIO, PRAISED.

Mr. Firestone, of Columbus, Ohio: I heartily endorse the report of this committee, and I am satisfied that we can all derive some benefit from it. In regard to the teaching of drawing in the public schools of my own city I think we have the most perfect system in our schools, there is anywhere in the country. Our exhibits at the Centennial, and other expositions, have always received the highest award. In our schools drawing is compulsory. At the age of eight years our children are obliged to purchase their drawing books; and in looking over their books I find that they know a great deal more about drawing at the age of 10 or 12 years than I ever knew in that line. In our city we have the Ohio City University, which has organized a course for young men from any part of the State, who are at liberty to work two or three hours each afternoon in the mechanical laboratory. The State furnishes them the iron and the wood, and the power of the tools to work them. A brother of mine attending the school surprised me with specimens that he had worked after attendance for a very short time. They teach them, for instance, the welding of iron—how it should be heated, at what heat they can make the best weld, how to strike the iron, and so on.

In our factory we get the best results from boys who have been with us from the time they are old enough to work; and we are always very anxious to get hold of a boy that is a good boy, and we take pride in teaching him. We have a great many boys in our employ to-day that in their several departments of work can do at least one-half more than nine-tenths of the old men. They become very expert.

On motion of Mr. Studebaker, the Report was accepted and the committee then directed to perfect plans.

CHAPTER V.

AN IMPORTANT EXPERIMENT IN TECHNICAL TRADE EDUCATION.

The Technological School of the Baltimore and Ohio R. R. Co.—How President Robert Garrett, of the B. & O. R. R., came first to consider the project of opening a school for the higher technical training of youth for railroad service—The address on Technical Education, by Hon. Teackle Wallis, before the Maryland Institute in 1881—General Counsel Cowen brings this at once to the attention of President Garrett, and suggests the opening of a school, in a formal communication—Dr. W. T. Barnard, Assistant to the President, directed to investigate and report—Professor Coler, and Mr. C. W. Scribner, aid in the investigations in Europe and the United States—The Library and archives of the U. S. Bureau of Education availed of—An admirable "Report on Technical Education in Industrial pursuits with special reference to Railroad Service" the result—The army of men employed by the Road—The need of better education of the employees of the Road emphatically shown—Present Educational condition of the dwellers along the line of the Road—Children of employees employed by preference, therefore the need that they be sufficiently educated—Apprentice training at the Mt. Clare Shops—The new school begun in 1885—Previous condition of these apprentice boys—Indifference of Mt. Clare workmen to the opportunity offered for reading books and papers—How the new requirements improved the class of apprentice boys—Need of a special Technological department shown—Difficulty of combining instruction with the shop needs—Desirability of special training for all classes of Rail Road employees—Lines of educational work suggested—Relationship of Johns Hopkins University to the B. & O. R. R.—Johns Hopkins a large owner and, consequently, the funds given to the University, largely invested in B. & O. securities—Relation of this movement to general interests of the Road—What may result if this promising experiment is persevered in—Analogy between the Military, Naval, and Railroad professions—The School—Executive order establishing the Technological School—Conditions for entrance—Examples of the examinations required—Circular defining reciprocal duties of Instructors and pupils—Reprts made by the Instructors showing actual working of the school—Summary by Professor Coler, of what had been absolutely accomplished by the School—Reports by the special teachers and instructors.

The Technological School of the Baltimore and Ohio R. R. Company.

One of the most interesting practical experiments in the line of definite technical education was made under the auspices of President Robert Garrett, of the B. & O. R. R. Co., in the planning and opening at the company's shops at Mt. Clare, near Baltimore, of a school designed to include a comprehensive course in the technical training of youth, with special reference to their after employment in Railroad Service.

This purpose, suggested to Mr. Cowan, General Counsel of the Company, by the thoughtful address on Technical Education, delivered by Hon. S. Teackle Wallis before the Maryland Institute, June 4th, 1881, and by Mr. Cowan, brought to the attention of President Garrett, on June 7th, resulted in a valuable contribution to Educational Literature in the admirable "report" made to President Garrett in 1886, by Dr. W. T. Barnard, "Assistant to the President."

In the preparation of this report Dr. Barnard, and his aids Professors Coler and Scribner, made careful studies of the literature and the Institutions of Technical Education in the United States and in Europe. All the facilities of the U. S. Bureau of Education were gladly accorded to these investigators and availed of by them. Many institutions in this country and in Europe were visited. The result of all this study and investigation was embodied in a special report* made to President Garrett. A school to be developed on the lines indicated in this report had been authorized by an order of the President in January, 1885, as an enlargement of the training which had been previously given to the apprentices. A beginning of the school was made in the autumn of the same year, and the reports of the Principal and teachers, which are appended to the main report as "Exhibits" "U." "V." and "W." give the plans of the school and the history of the experiment to January 1st, 1887. A subsequent change in the ownership and management of the B. & O. R. R. Company, resulted in the closing of this school and the apparent abandonment of the plan as here proposed. Whether this implies an absolute giving up of the plan, or only its postponement, I am not informed.

The plan was so thoroughly considered, and the report so carefully prepared, that I have judged it advisable to abstract such portions of the report as treat of the general topic, and to give them in an appendix to this volume.† As much relates to local conditions in the city of Baltimore, such matter is omitted; as being of less general interest. That portion of the report which relates directly to the school, and those "exhibits" which contain the reports of the teachers, are here given; as they embody its brief history.

The story of this experiment is, also, of value for its suggestiveness. It is here associated with the account of the technical school for carriage draughting, because this was, also, an effort to commence a technical school with a definite purpose of training men to expertness in a particular industry. The experiment here recited acquires an importance from the fact that it proposed to train its

*Technical Education in Industrial Pursuits, with special reference to Railroad Service. Report to the President B. & O. R. R. Company, by Dr. W. T. Barnard, Assistant to the President. October 1st, 1886. Baltimore: Press of Isaac Friedenwald, 1887. Pp. 168 and 70.

†See Appendix Y.

pupils to skill in an industry which directly and indirectly, affects all men; whereas "carriage draughting," concerns comparatively few. These two schools are, however, alike suggestive of the wide reaching possibilities of definitely directed technical training. In a calling so vital in its relations to the lives and the business of all men, and in whose varied departments and industries, such armies of men are employed, there hardly seems need of any argument to show the value of trained intelligence in every department of railroading. Had this educational experiment been suffered to continue long enough for its results to be tested, it seems quite possible that it would have been the precursor of a class of Institutions which, in their scope, including in their preliminary instruction all railroad men,—from the civil engineers to the track walkers, and taking in the apprentice boys in the foundries and shops, where rails and engines are made,—would almost have created a new kind of Industrial University. If this school, as planned, is to be classed simply as a "trade school," it is so in a far larger sense than that in which this term has hitherto been used.

The following pages, which close the report proper, treat directly of the conditions which led to the experiment; of the classes of the community from which the pupils are to be drawn; and of the school as planned.

The picture given of the ignorance of many of the families of workmen living along the line of the B. & O. road, may, possibly, startle some Americans from their fancied security in the intelligence of the people.

A whole generation seems, as there shown, to be growing up to a predestined life of the hardest and lowest form of labor, unillumined by any light of intelligence; and of such are to be the voters who are empowered to decide the policies and fate of the Nation. Out of one hundred and forty-seven future voters examined, Professor Coler reported that not a single one possessed sufficient acquaintance with the simplest elementary English studies to enable him to enter the lowest grammar school grade!—Surely some preliminary schooling seems called for here, before even the lowest grade of technical training can be made possible.

These pages of the report are inserted here as the best introduction to those of the "exhibits;" in which are given the plan of the school, the conditions of entrance, and the reports made by the teachers; which last show the actual working of the school while in operation.

Technical Instruction in the Baltimore and Ohio Railroad Service.*

SUCCESS OF B. & O. CO. ACHIEVED DESPITE THE EDUCATIONAL DEFICIENCIES OF ITS RANK AND FILE.

The commercial success achieved by the Baltimore and Ohio Railroad Company has in no sense resulted from the superior skill or intelligence of its subordinate officials, or of the rank and file in its several departments, but rather in spite of their deficiencies and through the force of character and capacity for affairs of its executives and staff. It is interesting to speculate upon the greater results that might have been accomplished had the executive ability, energy and money expended to secure its present position been supplemented by a corps of officers and operatives whose general education had been of a high order, and had been supplemented by technical training such as makes original thinkers.

EXTENT OF B. & O. MECHANICAL OPERATIONS.

In the B. & O. service there are now more than 24,000 operatives. The rapid extension of our lines, and the more than correspondingly rapid development of the Company's business, will make it necessary to largely increase this force from year to year. Referring to what has already been said on the subject of railroad companies manufacturing from raw materials, I invite your attention to the fact that of this force, about 8,000 men are engaged in the transformation of crude materials into rolling stock and other railway appliances or in their repair. I assume that the present policy has been found wise and satisfactory, and that the Company will hereafter do a still larger proportion of its own manufacturing and continue to do all its repairing. Under these circumstances the improvement of our mechanical force, as well as of the machinery in our shops, is a subject well worthy your most earnest consideration.

EXPLAINS WHY THE RANK AND FILE OF B. & O. R. R. HAVE LESS EDUCATION THAN EMPLOYES OF MOST OTHER ROADS.

The fact is that the Baltimore and Ohio Railroad Company has been peculiarly fortunate, in the sense that the geographical isolation of its main stem and branches has resulted in the gradual formation of a corps of operatives who, by descent, tradition and personal attachments, may be said to belong to the Baltimore and Ohio. These people are *sui generis.* From their earliest youth they looked forward to an active participation in the operations of the road as a means of livelihood, and all their aspirations and ambitions are associated with its service. This condition has been fostered by the custom, which for many years had the force of unwritten law, and which at the inauguration of the Relief Association was enacted into corporate law, by the official pledge of our President and Board of Directors to regard the children of meritorious employes as entitled, by right of their parents' faithful service, to priority of appointment, other things being equal, to all positions in the Company's gift. This promise has been reiterated and confirmed by yourself, by giving exceptional privileges to the families of employes, such as reduced rates of transportation, recognizing their applications to fill helpers' and apprentices' positions at all points on our lines, free tuition in the preparatory classes at Mount Clare, etc., as well as by your contemplated action in connection with the Mount Airy Home. Undoubtedly all this has resulted in creating and maintaining a corps of operatives of exceptional devotion and loyalty, and has in many other ways

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*See pages 139–168, of Dr. W. T. Barnard's report to the President B. & O. R. R. Co. Baltimore, 1886.

advantaged the service; but it has also, in some ways that were unforeseen, proven prejudicial to the Company's interests. For example, it is well known that the inhabitants along our main-stem divisions are disgracefully destitute of educational facilities, and this, coupled with the aforesaid sense of proprietorship in all minor positions in the service, with the prevalent idea that any education or knowledge beyond the bounds of his trade is of no practical use to a mechanical workman, and that an uneducated boy makes just as good if not a better mechanic than one who has an education, has created an indifference as to whether their children get even such elementary instruction as may be at their command, and is fatal to the future of boys, especially; who, inheriting the same pernicious belief, combine with it a natural disposition to have a good time when the day's work is done. It was an understanding of this condition of affairs that prompted Mr. Cowen to make the appeal quoted on the first page of this Report, and that finally led to the establishment of the preparatory school at Mt. Clare.

RESULTS OF INVESTIGATION INTO EDUCATIONAL QUALIFICATIONS OF B. & O. APPRENTICES IN 1885.

For several years prior to the issuance of your circular of January 15, 1885 (Exhibit A), the claims of each applicant for apprenticeship and helpers' places at Mt. Clare had been passed upon by a board of high and intelligent officers of the Company, and those selected on the score of fitness and merit, as well as to reward long and faithful service of their parents, were supposed to have materially elevated and leavened the younger element in the Mt. Clare shops—and, so far as I have learned, had done so. Yet, when I inaugurated a series of examinations not more difficult nor more technical than those which test the fitness of children to enter the grammar schools of most of our Northern cities and towns, it was ascertained that out of one hundred and forty-seven apprentices then in service, not one was able to pass those examinations, even after due warning and reasonable preparation. These examinations (the character of which is indicated by questions given in Exhibit X) developed the fact that a majority of our apprentices could not have entered an intermediate public school in—say—Washington, where the standard is certainly not too high; and yet the education of our Baltimore apprentices may, with reason, be assumed to be higher than that of the other apprentices scattered among the shops along our main stem and its branches, where school facilities are meagre and unsatisfactory. Our service is filled with men who must have been boys of just the type I have described, and I think you will not fail to perceive the gravity of this statement, upon recalling the testimony heretofore presented of the serious loss and other disadvantages of employing ignorant labor, and reflect upon the further fact that, where tastes for reading and study are not cultivated in youth, they are seldom acquired in later life by those engaged in manual occupations.

FAILURE OF MT. CLARE EMPLOYES TO UTILIZE EDUCATIONAL FACILITIES AT THEIR COMMAND.

In proof of this, I cite the fact that, though there is a commodious library and reading-room at Mt. Clare, fairly equipped with works on science and industrial mechanics, and where all the important scientific journals are displayed for the especial benefit to our employes, the record shows that, during the past year, out of an average of 3,000 workmen at Mt. Clare, fewer than 50 visited the library at all, and fewer than 15 utilized these journals; thus conclusively showing that they have not sufficient education to appreciate these valuable means of further improvement. Out of 16,120 books circulated during the year, but 1,816 were of a strictly educational character, and they were almost exclusively drawn out by young men

and boys attending our class-instruction. A very careful canvass last year domonstrated the fact that among this great mass of labor only one man subscribed to a technical journal, and that man was an ordinary mechanic. A logical deduction from this record is that our people have little or no knowledge of current improvements or of the results of scientific investigations of mechanical subjects and, as a rule, they only know methods crude and generally obsolete elsewhere, and observation confirms this.

NECESSITY OF EDUCATING B. & O. EMPLOYES INCREASED BY PRESENT AND CONTEMPLATED EXTENSIONS.

If the foregoing statements satisfy you—as I thoroughly believe myself—that it would have been greatly to the advantage of our company if not only its apprentices and journeymen, but also many of its officers, had received a scientific education, or at least a liberal technical training, my object will have been accomplished, and it will only remain for me to point out that what is true of the past has greater force as regards the future, by reason of the extensions and expenditures that are so rapidly expanding our system, and to suggest such a program for technological instruction in our service as will commend itself to your judgment.

Technological School at Mt. Clare.

HISTORY OF TECHNICAL INSTRUCTION AT MT. CLARE.

On the 15th of January, 1885, you issued án Executive Order (No. 6) providing for the school-instruction of the apprentices at Mt. Clare and other Baltimore and Ohio shops in Baltimore (Exhibit A), and making an appropriation for that purpose.

Prior to the establishment of school-work at Mr. Clare, the Baltimore and Ohio apprentices had neither incentive nor opportunity to develop into intelligent workmen, so that on starting the classes it was with great difficulty and only by absolute compulsion that the attendance of about forty shop-boys was secured. They were, with few exceptions, rude and almost unmanageable in the class-room, uninterested in the instruction, and scarcely able to await the hour of dismissal, when they would vacate the school-room rudely and in haste. Then the class-instruction was confined to the most elementary subjects, and the boys were unable or unwilling to read technical or scientific books with any show of profit. Now there are under school-instruction seventy-five as orderly and polite boys as are to be found in any high school of the country, and among the very best of them are boys who a few months ago were conspicuous for rudeness and insubordination. We have had classes of apprentices in geometry, algebra, physics, locomotive engine, mechanics, mechanical drawing, free-hand drawing, geometrical drawing, English and history, and a valuable method of instruction by special reading, selected and recommended by the teachers to each pupil, with special reference to his talents and the state of his education.*

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* Baltimore and Ohio Technological School Circular.

WHAT TO READ.

Baltimore and Ohio Employes' Free Circulating Library.

"Reading makes a full man."

This list is intended to suggest books that may be read with interest and profit by the students of the Technological School during the summer months. Other employes may, however, use the list to good advantage in choosing books for themselves and their families.

It is desired that all apprentices in the school should report, when the school opens in the fall, how many and what books they have read.

It may require an effort to become interested in some of the books named on this list, but they will,

REVOLUTION IN CONDUCT OF APPRENTICES ATTENDING CLASS INSTRUCTION.

Last year, as a rule, we had to compel boys to take up algebra and geometry; at this time many are promising promptness, regularity and other inducements to secure admission to those classes, and a number have become so urgent for higher science and mechanical studies (which the limited appropriation now at our disposal prevents us from inaugurating) as to create some embarrassment on our part, and some discontent on theirs.*

EACH EXAMINATION INTRODUCES A BETTER ELEMENT INTO THE SERVICE.

Many of these boys regularly spend their noons studying works in science and mechanics, going from shop to shop and from machine to machine, studying the principles involved in their construction and operation. Every examination for apprentices brings in a better class of applicants; as the result of which the standard upon which admission to the service is predicated is being gradually raised.

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any of them, amply repay a careful and thoughtful reading, while the effort and application that are required will constitute a wholesome mental discipline. The best way to become interested in a book that at first seems dry is to read some in it every day. If, however, after giving it several days' trial you fail to get interested in it, you had better return it and draw another book; but be sure not to give up too soon.

The best way to profit by what one reads is to read little at a time, but to read often and think much. It is an excellent plan to take notes of what you read.

BOOKS OF MECHANIC ARTS AND TRADES.

Locomotive-Engine Driving; Model Locomotive Engineer; Locomotive-Engine Running; The Locomotive Engine; Catechism of the Locomotive; American Locomotive Engines; Hand Book of the Locomotive; Practical Steam Engineer's Guide; The Steam Engine; Catechism of the Steam Engine; Steam Boiler Explosions; The Boiler Maker; Use and Abuse of the Steam Boiler; Pattern Maker's Assistant; Mechanic's Tool Book; Workshop Manipulations; Brass Founder's Manual; Manual of Wood Carving; Wood Working Tools; Complete Practical Machinist; The Young Mechanic; Slide Valve and Link Motion; Road Master's Assistant; Electro Magnets; Dynamo-Electro Machinery.

BOOKS OF INVENTION.

Great Facts, a Popular History of the Most Remarkable Inventions; Industrial Biography; Iron Workers and Tool Makers, by Smiles; Edison and His Inventions; Life of Richard Trevithick, with an Account of His Inventions; Growth of the Steam Engine.

BOOKS OF SCIENCE.

How Plants Grow; Cook's New Chemistry; Wonders of Science, or, Young Humphrey Davy; Manual of Assaying; Forms of Water; Faraday as a Discoverer; The World's Foundations; Geological Sketches; Lessons in Physics; Telegraphy in Theory and in Practice; Light and Electricity; Wonders of Electricity; Lessons in Electricity; Earth and Man; Volcanoes; Health and Good Living; History of a Mouthful of Bread; The Art of Prolonging Life.

Note.—Similar lists on History, Biography, Travels, etc., etc., have been furnished scholars from time to time.

* This is partly due to the fact that the classes in mechanics and physics are very interesting, and many apprentices who were not allowed to enter them until they acquired a certain perfection in algebra and geometry, have been promised technical and scientific class-instruction next year if they achieve that proficiency. We have had no trouble in interesting boys in drawing, because they, in common with other workmen and the foremen at Mt. Clare, recognize its direct help in their trades, and a strong sentiment at Mt. Clare has always favored that department of the school. The same sentiment is just as strongly against the teaching of mathematics, pure science, etc., doubtless because the direct influence of such studies upon their interests is not perceived. When, however, mathematical and scientific studies are asssociated with class-instruction in such technical subjects as the locomotive engine, steam, workshop appliances, methods of working iron and steel, and kindred subjects, an immediate interest and appreciation is developed.

RESULTS OF COMPULSORY INSTRUCTION OF APPRENTICES.

I have used this home illustration to show that, while it is true you cannot force a boy to lèarn (for education is a growth that comes from within, and no amount of compulsion or outward pressure can directly force profitable results), yet, where instruction is intelligently conducted, voluntary interest on the part of scholars and speedy improvement are almost sure to follow. The rapid advancement of the apprentice class at Mt. Clare, in point of ability and willingness to sacrifice pleasure to strict application to study, is very marked, and sufficiently proves the foregoing assertion. This instruction, though more general and less connected than would be desirable under a permanent organization, has, in a marked degree, promoted a sentiment of regard for and interest in knowledge of the principles upon which mechanical work is based. Many who previously were content to know how to do things, are now inquiring into the reasons for what they are doing.

It is not, however, to be understood that the foregoing statements apply to all the appentices who were in our service in Baltimore at the inauguration of instruction at Mt. Clare. or that the present classes are wholly composed of such apprentices.

BUT FEW OLD APPRENTICES FOUND AMENABLE TO DISCIPLINE AND INSTRUCTION.

Of those boys examined under your order of January 15, 1885, only 40 were found amenable to school-discipline and sufficiently grounded in the common English branches to justify the hope that, with such further academic training as our facilities afforded, they could profit by the proposed technical course to the extent of even qualifying themselves for graduation as mechanics; while, as aforesaid, not one of this large class of apprentices possessed sufficient elementary knowledge to permit of his entering upon the higher studies necessary to qualify him for an officer's position in the service.

REGULATIONS GOVERNING ADMISSION OF APPRENTICES TO SERVICE.

It being thus manifested that we had no material from which to manufacture efficient officers, nor were likely to acquire any under the then existing system, a general order was, at my instance, issued by the General Manager, promulgating regulations for the future admission of apprentices, and prescribing the minimum qualifications of candidates; which, while neither onerous nor of a high grade, provided a sufficient foundation for the technical instruction necessary to make a fairly educated mechanic.

LINES UPON WHICH INSTRUCTION HAS BEEN CONDUCTED.

In the same general order (which had your personal approval) the lines upon which it was then and is still proposed to conduct the educational work at Mt. Clare were defined in general terms, though no provision has ever been made for commencing the higher instruction therein contemplated. This general order is quoted in Exhibit U. While, owing to the exigencies of the service, it has not always been found expedient to reject *all* applicants for apprenticeship who failed to pass satisfactorily the preliminary examination, all recently appointed at Mt. Clare have been subjected to this ordeal; the result being that the new appointees are far more intelligent, better educated, and generally come from a better class than perhaps had ever before been admitted to your shops.

PRELIMINARY EXAMINATION PROHIBITORY TO UNEDUCATED SONS OF EMPLOYES.

For the reasons above given, this course has been almost prohibitory to the sons of old employes, only 32 of whom, out of a total of 95, have passed the examina-

tions since March, 1885. The immediate effect of this is that our employes are beginning to realize that the present is to be a permanent policy, and under this stimulating knowledge they are much more generally than formerly compelling their sons to attend school. As aforesaid, the mere public announcement of the proposed technological school at Mt. Clare attracted to our monthly examinations a very superior class of young men, many of whom, having entered under the apprentice regulations, are now prepared for the cadet course as soon as it is inaugurated.

EMBARRASSMENTS ATTENDING CLASS INSTRUCTION.

The capacity and the elementary knowledge possessed by the individual members of a large class of boys collected under such varying conditions as those narrated above, differs very greatly in degree, and it therefore became a serious problem how to arrange their studies so as to bring them under general class-instruction.

ATTEMPT TO INCREASE EFFICIENCY OF ALL APPRENTICES BY ORGANIZING SEPARATE CLASS INSTRUCTION FOR DIFFERENT GRADES.

It was clearly futile to expect any material advancement in scholastic or technical knowledge of the mass of apprentices then in the service, and yet where so much material was going to waste it was our evident duty to attempt to enhance its ultimate value to the company; therefore, the course of instruction was framed with special reference to its practical utility in, first, advancing the entire force of apprentices within reach of its influence in their several mechanical pursuits; secondly, in advancing the theoretical instruction (as far as might be practicable with the limited means at hand) of such apprentices as past examinations had shown to be possessed of sufficient common-school education to justify the hope that, without additional school-training in academic branches, they could be educated to the standard of good officers or, at least, of first-class mechanics; and thirdly, in giving such special instruction of a higher character, as our means afforded, to those who, entering the services under the new order of things, were found sufficiently advanced to receive it with profit.

DIRECT BEARING OF SCHOOL INSTRUCTION UPON SHOP WORK PARAMOUNT.

It was deemed of paramount importance that, so far as might be practicable, the work of the school should have a direct bearing upon, and an immediate connection with, the various duties in the shops with which those under instruction were or might be charged. Realizing how materially the value even of an otherwise uneducated mechanic is augmented by facility in making and reading working drawings, an effort was made to give systematic instruction in drawing to as many apprentices as our limited number of teachers and small class-space permitted. I have already reported that this part of the teaching was well received and has been measurably successful; about 60 boys taking two drawing lessons each week, aggregating eight or nine lessons per month; and this alone cannot fail to increase their usefulness to the Company.

DIFFICULTY OF COMBINING SCHOOL AND SHOP INSTRUCTION WITHOUT CONFLICT OF AUTHORITY.

It was a simple matter to provide for such academic instruction as it was deemed expedient to give apprentices, and also for the examination of those wishing to enter the service, but very difficult to devise a satisfactory yet efficient plan of shop-instruction which, while bearing directly upon the apprentices' daily duties, should

not conflict therewith. As the result of repeated conferences with the General Manager and the heads of mechanical departments, a series of regulations was formulated, defining the jurisdiction of the technological instructor and the shop authorities respectively over apprentices, and promulgated by the General Manager (Exhibit V). This order was measurably effective, though, as was to be expected from a dual authority, opposition was engendered, and the instructors have not received such cordial support from some of those immediately in charge of the mechanical operations of the shops as would have made their labors effective in the highest degree. If you conclude to continue technological instruction at Mt. Clare, this phase of the subject will need further careful consideration and revision.

It is not an easy task to present novel educational methods through the medium of reports which cover a limited experience; while many beneficial and potent results cannot be shown at all by such means. In fact, though we see that education affects people morally, mentally and physically, and that where intelligence abounds there are prosperity, general contentment and happiness,— while superstition, perversity and dissipation are the handmaidens of ignorance,—it is one of those intangible things which, though potent in results, is not to be measured by and material standard.

REPORTS OF INSTRUCTORS ON SCHOOL WORK AT MT. CLARE.

Still it is very necessary that you and others who may be called upon to consider the expediency of continuing and enlarging this instruction, should thoroughly understand what has been accomplished by the expenditure already made, and perhaps I cannot give you this information more accurately than by referring to the reports of the several instructors, covering the entire period of instruction at Mt. Clare, and they are accordingly appended to this report as Exhibit W.

MONEY APPROPRIATED FOR MT. CLARE SCHOOL WELL SPENT.

I think the facts shown in that Exhibit and in Exhibits U and V will convince you, or any other fair-minded man, that, despite the difficulties inherent in the undertaking itself; the misunderstandings and, in some cases, the outspoken opposition of some of our shop officials, and the educational deficiencies of the boys who were first brought under school-discipline, much absolute good has been accomplished by the tentative instruction at Mt. Clare, and that your appropriation has been well expended, with substantial benefit to the service. Had the school received that hearty co-operation and encouragement it deserved, the results would have been more tangible and far more valuable; but quite enough is set forth in these reports to prove, without the aid of testimony or the cogent argument cited in the preceding pages, that this plan of technological instruction would, if elaborated and permanently established, be productive of economic results.

Your attention is especially invited to the dozen drawings accompanying this report, which are the work of regular apprentices, all of whom, with one or two exceptions, have entered the service since the school commenced, and most of whom are apprentices of less than a year's service. They show something of the work of one department only, but are by no means exceptional in their excellence.

INSTRUCTION AT MT. CLARE HAS DEVELOPED APTITUDES AND HAS GENERALLY ADVANCED STUDENTS.

The results of our instruction in science and mechanics, and in other branches, though less tangible, are equally as great; the former especially having developed habits of thought, observation, inquiry and definite expressions that far surpass what I had supposed possible under prevailing conditions.

Of course much remains to be thought out and experimentally applied before an harmonious practical curriculum for a technological railroad school can be perfected; but any further money appropriated in this connection will, proportionately, be much more remunerative in valuable results than what has already been expended, and the experience gained by our teachers will enable them, hereafter, to avoid many mistakes and to master many difficulties that to the novice might seem insurmountable.

SCHOOL WORK AT MT. CLARE ORIGINAL IN CHARACTER, AND HAS SOLVED PROBLEM OF CONNECTING SHOP WORK AND SCHOOL INSTRUCTION.

It is also to be borne in mind that the preliminary work already performed in the Mt. Clare School has largely been original (for the experience of neither our universities, colleges nor technical schools could be of much service to us in combining school and shop-instruction). There were really no precedents to guide us in shaping a course of instruction for railroad shops; for while in Europe there are numerous technological schools most of them bear on industries of a different type from railroading, and even the few that are directly connected with railway corporations have been in operation only a short time and are formulated on foreign methods and necessities, and their courses of study could not effectively be introduced in this country. It is, therefore, gratifying to be able to state that several well-known and experienced scientists and educators have expressed the view that, in many respects, the Mt. Clare School is successfully working out problems in the line of connecting shop-work and school-instruction, and the direct application of the latter to the former, that no attempts had previously been made to solve.

INSTRUCTION AT MT. CLARE PECULIARLY VALUABLE IN EXPERIENCE OF SHOP AND SCHOOL WORK.

As might naturally be supposed, the shop and class-instruction of the apprentices at Mt. Clare during the past twenty months has afforded us not only an insight into the methods of administration and practice of those works, but also a full realization of the difficulties which will be encountered in planting a permanent system of technological instruction in the Baltimore and Ohio service. In this experimental work our teachers have acquired peculiarly valuable experience and knowledge of the lines upon which that instruction, to be successful, must be conducted. This knowledge is unrecorded, and, were it certain you would continue this educational work, might profitably be incorporated in this report; but it can speedily be formulated upon call, and I therefore close this particular branch of the subject with some general considerations.

What has been said in general terms as to the method of educating apprentices in the Mt. Clare shops applies with equal force to our entire mechanical department. The old system of indenture in this country involved a definite responsibility on the part of the employer for the skill of the boys who graduated from his shops, which in fact has long ceased to exist, and, generally speaking, all that remains of the apprentice system of former days is an erroneous assumption in the public mind that, at the expiration of four years' service as a so-called apprentice, a boy possesses the skill and is entitled to the compensation of a journeyman.

B. & O. SYSTEM OF APPRENTICESHIP ERRONEOUS, MISLEADING, AND INEFFICIENT.

So far as the Baltimore and Ohio Railroad is concerned, the observations of six years convince me that this term "apprentice" is an entire misnomer as applied to the boys in our shops, who can only be classified as "helpers" and "laborers;" for they do not receive such instruction as is necessary to make them intelligent me-

chanics, and though, from the nature of their work, they necessarily, in four years' service, acquire a certain amount of manual dexterity, few of them have, at the expiration of that term, attained to such a degree of expertness and general knowledge of the several branches of their trades as would justify a great corporation certifying them to the world as skilled workmen. *

LABOR OF BOYS IN MACHINE SHOPS.

Much of the light and low-grade work in the manufacturing and repair shops of a railroad can be economically and successfully performed by uneducated boys and, in an emergency, much of the current work of such shops could temporarily be undertaken by them. But mere expertness in running a few machines (which may be acquired by mere repetition), even when supplemented by manual dexterity in some branches of a trade, does not take such help out of the category of uneducated labor.

TERM "APPRENTICE" A MISNOMER.

Helpers and laborers only they are, and helpers and laborers they will remain to the end of the chapter, under the system of handling apprentices now in vogue in our shops. Indeed I understand that no difference in pay is maintained in our Mt. Clare shops between "helpers" and apprentices. Of course I know that it would be unwise, in the present condition of the labor market from which this Company draws its supply, to reject the services of every mechanic who did not come up to a high standard, but nevertheless the Company loses money by employing such people, and should at least make a well-defined distinction between the pay and rating of a properly educated artisan and of one whose only qualification is manual skill. In order to secure substantial improvement in our mechanical service there must be a point of departure, and I think you will find none better than that here indicated.

RECOMMENDATIONS AS TO EMPLOYMENT AND PROMOTION OF APPRENTICES.

To make a practical application of this view, I submit that no young man, whatever his length of service with the Company may have been, should receive the designation or the pay of a journeyman until it is demonstrated by examinations, as well as by actual work, that he possesses the theoretical knowledge as well as the manual dexterity which in advanced mechanical centres is accepted as the standard of a skilled artisan. Also that the rule which requires all boys applying for service at Mt. Clare to pass an examination equivalent in grade to that which admits boys to our intermediate schools (or at the maximum to our grammar schools), shall be continued and extended over our entire system; that where the exigencies of the service require the employment of a larger number of boys than can be found qualified for this examination, all applicants shall nevertheless be examined and their status and permanency in the service thus determined. In other words, that all boys found lacking in the prescribed mental qualifications, but whose services are needed, shall be rated as helpers or laborers, on a progressively lower scale of wages than apprentices of same length of service receive; that while the sons of our em-

* "Investigations in the shops, by conversation and observation, have developed the fact that many boys or young men had completed or nearly completed their apprenticeship in the machine-shops without being able to tell the difference between cast and wrought iron; without knowing whether steel is a native or manufactured product, and equally ignorant of many other simple, though important and significant, facts which are intimately related to their trades."—[*Vide Report Tech. School Principal, Ex. W.*]

ployes shall still have the preference of appointment, when their education is ascertained by an examination to equal that of their competitors—*and not otherwise*, after admission their examination and scholastic records shall determine their advancement, or retention, should a reduction of force occur. The present form of indenture of apprentices should be modified to accord with General Order No. 5 of January 15, 1885, General Manager's Office, and by further provisions that no apprentice shall be entitled to additional wages at the expiration of each year's service, until he has passed the annual academic examinations of his grade; that no apprentice shall be rated or paid as a journeyman until, in addition to completing the usual shop-course, he obtains a certificate of graduation from the journeyman's course of school-studies. The wisdom of such provisions is too patent to need illustration.

DISCUSSES DESIRABILITY OF EMPLOYING GRADUATES OF TECHNOLOGICAL INSTITUTIONS IN RAILROAD SERVICE.

In this connection, it is important to recall to your mind what has been said about employing the graduates of technological institutes in railway service, because that has a material bearing upon the proposition to establish a school devoted exclusively to the education of railway officers and apprentices. At the present moment especially, our system is undergoing a reorganization, and in many respects a development, that offers an exceptionally favorable opportunity to supplement the practical experience and technical knowledge of those subordinate officers charged with the details of our transportation, mechanical and road departments, with modern practice as taught in our best technological schools. By this I mean that the selection of a limited number of technological-school graduates for special instruction in the cadet course above outlined would, at a comparatively early date, provide the service with assistant foremen, supervisors, etc., who would elevate and educate those immediately above and surrounding them, while the conservatism of their superior officers would neutralize their inexperience in technical details, temper their zeal, and reduce their theories to practical applications serviceable to the Company. While, for the reasons already stated, it is believed the appointment of technological graduates to positions of responsibility in railway service would not prove as satisfactory as the policy of securing boys well grounded in elementary studies and then educating them as specialists in railway theory and practice, there is much that can be urged in favor of their appointment as cadets, as combining the elements of economy and immediate results which, in our present situation, commends that course to your favorable consideration. This report contains conclusive testimony as to the facility and rapidity with which intelligent technological scholars absorb and assimilate a practical knowledge of the trades and professions with which they become associated, and I think no one who has read it would doubt that this plan would at least yield a profitable return, through the elevation of the *personnel* of the service and the introduction of scientific and modern mechanical processes to our practice.

TECHNOLOGICAL SCHOOL GRADUATES WOULD MAKE DESIRABLE SUBORDINATE OFFICERS AND TEACHERS.

To reinforce this view, let me ask you to reflect upon the results that would surely follow the assignment to each of our Mt. Clare shops, after some specific instruction in railroad matters, of one or more assistant foremen, selected from the higher graduates of our best mechanical schools. You cannot fail to realize that such a policy would soon produce a revolution in the social status and in the practical mechanical operations of those shops which would greatly advantage the service generally. Another result would be that this corps of assistant foremen and supervisors, who would soon acquire practical experience and the theories of

economy which form the groundwork of your administration, would furnish just the talent now needed for teaching the younger element of the service—*i. e.* teachers combining theoretical and technical knowledge with such experience as would give them an appreciation of the lines of instruction that would yield the most practical and economic results.

APPROVES CONTINUING PLAN OF INSTRUCTION ANNOUNCED IN JANUARY, 1885.

General Order No. 5, of January 15, 1885 (Exhibit U), though purposely made general and tentative in character, in order that we might profit by future experience, still very well expresses my judgment as to the lines upon which the proposed educational work should be conducted.

The plan outlined in that order contemplates:

1. Instruction (in the apprentice class, of such boys now in or hereafter admitted to the service as can pass the examination therein indicated), of a character that will make them skilled and intelligent mechanics. Such apprentices as, in this course, developed a fair amount of ability and fidelity would, naturally, graduate into the second or Cadet class. This *first class* course should, however, provide within itself all the elements of technical instruction necessary to complete a journeyman's education.

2. The *Second or Cadet course* should also be complete within itself, and should provide such technical instruction in all the departments of railway service as would fit its students for all subordinate positions of responsibility and trust in the service—corresponding to what is known in European schools as the foremen's course of study. This course, while involving more thorough and wider theoretical instruction than the apprentice course, should, to the greatest extent possible, be framed with reference to the practical mechanical operations of the shops and of the service generally.

Unless very radical changes can be effected in the common-school methods practised in Baltimore, I apprehend that a very small proportion of the apprentice class will be able to take this higher instruction, and that we will have to look to the graduates of technological and science schools in other sections of the country that *do* afford industrial education to their citizens, for the material to constitute our cadet class. I look with regret upon this prospect, having a strong bias towards the development of local talent; but in this connection public considerations must be made subservient to our corporate needs. The widespread interest developed outside of Baltimore in the technological work at Mount Clare, and the numerous applications for admission to that school from the graduates of technological and science schools and others of equal mental discipline, give full assurance of an unlimited source of supply, and that this class will not only provide subordinate officers in sufficient numbers to meet the utmost demands of the service, but also men whose primary education will qualify them for still higher positions.

3. It will be the object of the *Third or Cadet Officers' course* to give to those who graduate with honor from the second class (and who have therein shown themselves possessed of ability and educational qualifications above the average) further technical training, of a still higher and more comprehensive type, which, when combined with familiarity with the operations of the various departments of the service, will go far towards qualifying the students of that course for the highest positions in the Company's gift. To this end, opportunity should be afforded the pupils of this course, in its last year, to actively participate in the production, care, repair and improvement of railway plant and in the practical operations of the service. This could readily be done—and with advantage to the service also—by distributing these students among the several departments as assistants—at the same time maintaining their connection with the school for further educational purposes. I have already

shown how such an infusion of new blood into our mechanical and operative departments would inure to the benefit of the Company.

In the apprentice course, school-instruction should be made secondary to shop-work, while in the higher courses shop-work should always be secondary to mental training.

CLASS INSTRUCTION INAUGURATED AT MT. CLARE SHOULD BE EXTENDED OVER ENTIRE SYSTEM.

Although the foregoing relates especially to instruction in Baltimore, the plan has been drafted in a more general sense, and contemplates the gradual extension of this educational movement over our entire system. While Baltimore will always be the center of such a movement, I apprehend no great difficulty in extending the apprentice course, at least, over the entire road, by establishing night-schools for drawing, mathematics, and elementary science, or securing the introduction of our boys into such schools as are already in operation, and the modification of their curriculum in the manner indicated. A cheap provision for such elementary instruction can be made by gradually transferring the young graduates from the Mt. Clare School to our divisional repair shop as assistants, and requiring them to take charge of these night-schools, and of the shop-instruction and supervision of apprentices, under a similar plan to that now in force at Mt. Clare—with, of course, such modifications as local differences and experience may suggest as desirable.

REASONS WHY ALL APPLICANTS FOR APPRENTICESHIP SHOULD BE EXAMINED.

The statement in Mr. Coler's report (Exhibit W) that not one of five hundred apprentices examined in and out of Baltimore was able to pass a very simple examination, gives great force to his recommendation that the present system of a preliminary examination as a condition of apprenticeship (which has been in operation in Baltimore for the past two years) shall be enforced in all the shops of our service. This preliminary examination has worked admirably, and, if enforced throughout the service, will secure a class of workmen of greater intelligence than now operate your shops; and lead to improvements in machinery, economical methods of labor and avoidance of accidents. Even though you may not finally determine to inaugurate the educational work herein proposed, the system of preliminary examination should be maintained and extended as a condition of apprenticeship.

In course of my investigation of this subject I have accumulated a large mass of data relating to the organization, management and results of technological and science schools, which it is not necessary to incorporate in this report, but which would be of material assistance should the Baltimore and Ohio Company decide to convert the present experimental teaching at Mt. Clare into a permanent bureau or department for educating officers and skilled artisans for its service.

SUGGESTS LINES UPON WHICH TECHNOLOGICAL WORK SHOULD BE CONDUCTED.

In the event of favorable action upon this school-question, I would recommend that the details of organization, the preparation of courses of study, etc., be entrusted to a commission; some of whose members should be the most experienced and successful educators that can be found in the technological field, while others should not only have a wide mechanical knowledge, combined with practical experience in the application of mechanics to those industries connected with railway service, but should likewise be thoroughly conversant with the methods and requirements of that service *as conducted in this country.* Such expert talent *can* be had and, if the subject is to be pursued at all, its importance demands that no

pains or reasonable expense should be spared in getting a right start. Indeed the ultimate success of such a measure would mainly depend upon the wisdom and discretion of those who planned its details. Such a commission (aided by the local and technical knowledge of intelligent representatives of our administrative and operating departments, and by the experience of the teachers at Mt. Clare, which, in this connection, would be invaluable); performing its labors with courage, yet caution; realizing that the value and therefore the life of such a school depended altogether upon its usefulness in increasing the efficiency and economy of railroad operations, could, I doubt not, devise a system of instruction that would accomplish fully as great practical results as have ever been achieved in the field of industrial education.*

WHAT MT. CLARE SCHOOL SHOULD AIM TO ACCOMPLISH.

The great aim of the Mt. Clare School, if it is to be maintained, should be a combination of theory and practice, by the daily application, in the workshop, of the theoretical instruction received in the school-room. I cannot impress upon you too strongly the impracticability of attempting to teach trades, or to fit youth for the practical work of life by such *theoretical instruction* and *casual* practice as are given in most of our so-called trade schools. Our Mt. Clare classes in physics and mechanics are now taught to apply principles for themselves, so far as time and apparatus will permit, somewhat after the order of common-school instruction practised on the Continent, and described by Matthew Arnold in the October number of the *Century*, and this practice has given satisfactory results, though not such as would have been secured by a cordial co-operation between the shop authorities and the school instructors. If the school is reorganized with more space and apparatus, and on a practical plan of supplementing class-instruction with work in the shop, or, more properly speaking, of systematically adapting school instruction to the current work of the shops, you will soon see a marked improvement in the mechanical operations of those shops.

WHAT B. & O. R. R. CAN REASONABLY DO TO PROMOTE TECHNICAL EDUCATION.

I have gone into this matter at length, because it is important you should fully realize that our great want is the technical education of our people; that to educate for railroad work, even the *best* course of technical study must be supplemented with practical instruction in the workshop and in the administrative and operative offices, and that no technical course for railroad people could profitably be conducted in any school without immediate access to workshops and plant in all phases of operation, construction and maintenance; that, in its corporate interests, the Baltimore and Ohio Company could well afford to provide this practical knowledge and a certain amount of school-instruction, upon the plans outlined in connection with the Mt. Clare works; but while that plan contemplates a selection

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*Dr. Hall, of the Hopkins University, in response to a request of one of our teachers for advice on the subject of a suitable course of study for Mt. Clare apprentices, said in substance that the subject involved one of the hardest and most peculiar questions in education; that to formulate such a course would not only require an intimate knowledge of the wants of the Company and of the service of its various shops, as well as of the work and results of the leading industrial schools of the country, but would also take at least six months of his undivided time. I cite this statement of one of our most experienced educators merely to show that the subject is one of great complexity, that cannot be safely entrusted to any but the learned and experienced.

of studies from the different engineering courses in connection with other subjects that bear directly upon railroad interests, this company cannot be expected to take the place of our colleges and universities in developing special aptitudes.

RELATIONSHIP OF JOHNS HOPKINS UNIVERSITY TO B. & O. CO., AND WHAT IT SHOULD DO TO AID LATTER IN ITS EDUCATIONAL MOVEMENT.

I have elsewhere (pp. 77–78) alluded to the material influence which the Johns Hopkins University should—but does not—exert upon our service. I have also shown how the vital interests of the former are involved in the prosperity of the latter, and have referred at length to the intimate relations existing between the Johns Hopkins University and this Company. Had that intimate connection not existed, I should not have felt justified in criticising, in this report, the policy and methods of its management; but as that association *does exist in fact*, and as I consider the objects this report is intended to subserve are—in a reflex sense—as vital to the Hopkins University as to the railroad itself, I have felt as free to comment upon its methods as upon our own. The prime need of the University is the greatest attainable income from its endowment compatible with security. The greater portion of its capital being invested in Baltimore and Ohio securities, it is fair to assume that the first desire of its trustees is the permanency and commercial success of that road. The great influence of technical education upon the prosperity and net earning capacity of industrial corporations (among which must be classed the Baltimore and Ohio) is so clearly and unquestionably shown in this report, as is also the low educational standard of the community from which this service draws its main supply of labor, that it seems only neoessary to point out the relations which these interests bear to each other and the need that exists for the aid which the University could so effectively give, to secure the hearty approval and co-operation of its trustees and faculty in judicious efforts to elevate our service. They are eminently qualified to appreciate the value of intelligent and scientific methods, and I need hardly point out that, as it is very doubtful if the University could get a better investment for its endowment than that it now holds in our securities, the best way to make their endowment highly renumerative and permanently secure is to follow the lines herein indicated, and that any expenditure or sacrifice they might make in this connection would be a wise insurance of their capital against depreciation.

From an outside point of view, it would seem as though so large a shareholder in the Baltimore and Ohio Company should take a more lively interest in the affairs of that corporation than it has done, and that pride, no less than self-interest, should prompt it to supplement our efforts by remodeling its curriculum so as to afford better facilities to the general public of Baltimore, and especially to those in our service who may develop a capacity for higher instruction than will be obtainable under the proposed Baltimore and Ohio program; which, while providing a very substantial foundation, cannot undertake to give advanced instruction in engineering and other higher branches of scientific and mechanical knowledge.*

* That a railroad company *as such* would not be justified in furnishing means for such an extensive course as would accomplish all the objects herein viewed, and that, without public or private assistance, its efforts must at best be devoted to affording thorough instruction in those *elementary* branches which will give the most practical and immediate return to the *railroad*, is made patent by the following considerations:

Engineering, though important, is only a part of what must be taught in a course intended to fully qualify young men for the higher walks of railroad life, and yet to provide the necessary buildings, apparatus and a corps of suitable instructors to

Certainly neither this community nor our country at large would be the losers, if in order to inaugurate such a course, it was found even necessary to curtail its present program, which is currently recognized as aiming to devote the University to original research and to finishing (in its highest sense) the education of the graduates of our other universities.

WHAT PROGRAM OF JANUARY 15, 1885, FOR EDUCATING B. & O. EMPLOYES REALLY SIGNIFIES IN ITS RELATION TO GENERAL INTERESTS.

In conclusion, I beg to say that, while of course I desired and earnestly endeavored to obtain the most practical results for the Company, in return for its expenditures, your order of January 15, 1885, had, to my mind, a much greater significance than attached to a course of mere experimental instruction of ignorant apprentices. I clearly realized that this attempt to influence the methods and practices of a great industry, by carrying systematic mental instruction into its workshops, was really inviting a public determination of the question whether or not systematic technological instruction, under corporate auspices (*and therefore under the most favorable conditions*) was practicable; and if practicable, economical and otherwise desirable. If an experiment, conducted as this was to be, under the supervision and control of a great corporation, whose wealth, thorough organization, commercial, manufacturing and transportation operations and interests, combined with its well-known desire to elevate its employes, failed of success, no other railroad or other large industrial corporation would be likely, in the near future, to renew the attempt to graft upon our democratic institutions the system of technological instruction pursued abroad with material advantage to all concerned.

B. & O. PROGRAM AN ENTIRELY NEW DEPARTURE IN INDUSTRIAL EDUCATION AND WORK.

Another consideration which gave me great concern in this connection was that the program announced in your order was substantially novel in this country, both in respect to educational and industrial practices, in that it contemplated, on the one hand, reversing the present steady tendency of our technological and science schools towards the theoretical rather than the practical in mechanical and kindred studies, while, on the other hand, it proposed making school-instruction directly supplemental to the usual shop-work of apprentices and others—*professedly* for the purpose of elevating and diverting the mechanical and other operations of a great corporation from obsolete to modern practice—a plan that, so far as I am able to learn, has never before been practically attempted in this country. The idea of such a school is just as new in the line of school-work and education as railroading was in the line of transportation fifty years ago.

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teach that branch alone, in its advanced stages, would require a very considerable annual appropriation.

In Cornell, as I am informed, the faculty of civil engineering alone includes nine teachers, while Stevens Institute, which provides only for a course in *Mechanical Engineering*, has a corps of twelve teachers, and Rensselaer Polytechnic Institute, Troy, N. Y., provides a corps of nineteen teachers for advanced instruction only in *Civil Engineering*—the conditions of admission requiring students to be well grounded in elementary studies. True, some of the instructors in Cornell teach in other departments, but then the students of engineering get part of their instruction in allied departments. A course in any one kind of engineering would require the full time of at least six teachers. To secure first-class men for these positions would necessitate a large expenditure.

WHAT IT MAY LEAD TO IN A NATIONAL SENSE.

If, under this program, it could be clearly demonstrated that a bureau or department established for the specific education of railroad officers and artisans to a higher than the current professional standard was really a practicable and economic adjunct to the operative, administrative and executive departments of American railways, it would not be extravagant to hope for a general industrial educational movement, not only on behalf of the half million men engaged in railroading, but such an one as has been vigorously advocated by a large number of our wisest citizens, irrespective of class and profession, as well as by intelligent workmen in various sections of the country (*vide* p. 65). A movement that, though originated by the potent agency of self-interest, would finally reach beyond all sordid considerations and result in improving the entire mass of our laboring population, and in elevating the United States more nearly to her proper rank among the industrial nations.

ANALOGY BETWEEN THE MILITARY, NAVAL, AND RAILROAD PROFESSIONS.

Reference has previously been made to the analogy between railroading and our military and naval services. An intimate acquaintance of many years with the details of military organization and service, and a more general yet practical knowledge of the systems under which our navy and railroad properties are operated, has perhaps specially qualified me to appreciate what is common to them all, and I have been greatly impressed with the belief that the educational measures and methods which have made our military and naval officers professionally so efficient, would prove equally efficacious if applied, with necessary modifications, to railroad service.

In closing this report it is proper to express my sincere regret that my own want of experience and fitness for the task has necessitated the preparation of such a lengthy paper, in order to intelligently place before you information that others better qualified could have more clearly and succinctly stated. On reviewing these pages, I observe that they bear evidences of spasmodic effort, and, in a certain sense, of evolution of thought, which is additional matter for regret; but the subject is of such a character as to demand for its satisfactory presentation a consecutive research and study which press of other and onerous duties altogether precluded me from giving it. The same causes operated to prevent an earlier conclusion of my task.

In thus relinquishing all further responsibility and connection with this very interesting but exacting subject, I desire to say that, in stating facts fearlessly and expressing my own views frankly, I have been governed solely by a desire to elevate the *morale* and efficiency of the Baltimore and Ohio Railroad and its allied interests and, incidentally, to advance the industrial education—and as a necessary consequence the material prosperity—of this community.

Respectfully submitted:

W. T. BARNARD,
Assistant to President.

The following "Exhibits" which show first the executive order, authorising and creating the school, and then the proposed classification of the several departments of the school; the preliminary examinations, physical and intellectual, of proposed students; the reports of the Principal, and the several teachers, giving a view of the school both as planned and as put in operation; are here inserted

to complete the account of this incompleted Educational Experiment. The several exhibits omitted are given to accounts of European and American Technical Schools and quotations from various authorities, some of which will be indicated when the earlier portions of the Report are abstracted for the Appendix.

EXHIBIT A.

EXECUTIVE ORDER FOR THE INAUGURATION OF SCHOOL INSTRUCTION AT MT. CLARE.

Executive Order No. 6.

BALTIMORE & OHIO RAILROAD COMPANY,
OFFICE OF THE PRESIDENT,
Baltimore, January 15, 1885.

The inauguration of a Baltimore and Ohio Technological School for the promotion of a higher course of instruction for the apprentices of this service than that now pursued, with headquarters at Mt. Clare, Baltimore, and conducted under the superintendence of a board of seven directors, appointed annually by the President of this Company, is announced.

Messrs. John K. Cowen, E. J. D. Cross, Dr. Charles M. Cresson, Andrew Anderson, Dr. W. T. Barnard, Bradford Dunham and Charles Selden are hereby appointed such directors for the calendar year 1885.

The course and method of instruction in its several departments, and the operations of the Technological School, shall be governed by regulations prescribed by its Board of Directors.

In furtherance of the objects for which this school is founded, and to secure uniformity and discrimination in the employment of apprentices in all departments, the General Manager will promulgate rules regulating their appointment and service.

In the establishment of a technological school the Company affords the youth in its employ opportunities for obtaining a liberal technical education far superior to those enjoyed by the employes of other railroads. The examinations prescribed in the course of the Technological School will be very thorough, and will require from the apprentice a close and persevering attention to study, without evasion or slighting of any part of the course, as no relaxation of any kind can be made by the Board of Examiners; and, as the Company will hereafter endeavor to advance the graduates of the Technological School to positions of responsibility and trust in its service, only those who demonstrate willingness and ability to qualify themselves for advancement will be retained.

The General Manager will convene a Board of Examiners, consisting jointly of two medical examiners of the Relief Association and three instructors of the Technological School, whose duty it shall be to examine and classify all apprentices now in service in accordance with the standard of qualifications prescribed in his General Order on the subject. This board will visit each station where apprentices are employed, and finally report, in writing, to the General Manager the result of their labors.

RORERT GARRETT,
President.

EXHIBIT U.

General Order No 5.

BALTIMORE AND OHIO RAILROAD COMPANY,
GENERAL MANAGER'S OFFICE,
Baltimore, January 15, 1885.

Executive Order No. 6, dated January 15, 1885, from the office of the President, is republished for the information of those concerned [see Exhibit A]:

In accordance therewith, the following general regulations governing the appointment, admission and service of Apprentices of the Baltimore and Ohio Railroad Company are announced, superseding all previous regulations relating thereto:

SECTION I.

1. On and after this date all Apprentices will be embraced under the following general designations, and graded into three classes—viz.:

1st (Junior) Class, B. & O. Apprentices; 2d Class, B. & O. Cadets; 3d (Senior) Class, B. & O. Cadet officers.

2. The term of service in the several classes will be: First class, 4 years; second class, 3 years; third class, 3 years.

3. As the Baltimore and Ohio Railroad Company undertakes the expense of educating Apprentices and Cadets passing the physical and educational examinations, it will expect the privilege of availing of the services of such as are competent for its purposes at fair salaries, for at least three years after graduation.

4. Apprentices and cadets will be amenable to the discipline and regulations of the Company, and violation of its rules, neglect of its interests, destruction of its tools or waste of its property, will be cause for dismissal. But, while liable to suspension by their immediate official superiors, Apprentices and Cadets cannot be dismissed except by the direct action of the General Manager of the Company; his decision as to dismissal being final and conclusive.

5. The pay of Apprentices and Cadets in the several classes will be:

	Per day.			
	First year.	Second year.	Third year.	Fourth year.
First class	\$0.70	\$0.80	\$0.90	\$1.00
Second class	1.00	1.12½	1.25	....
Third class	1.50	1.75	2.00	....

commencing with the date of their admission into the service. As an incentive for efficiency, fidelity, industry, energy, and care of its property, the Company will give to each of its Apprentices, on the completion of his term of four years' service in the first class, and to those Cadets passing through the full course of the second and third classes, whose record for that time has been praiseworthy and satisfactory, a sum equal to eight and a half cents per day for each full day they serve in the first class, and twelve and a half cents for each full day they serve in the second class.

6. The Cadets of the second and third classes—and all students of the Technological School—will be required to wear in the School, on all public occasions, and at any and all other times designated by the General Manager, a prescribed uniform, all the parts of which will be of like pattern and will be furnished by the Purchasing Agent—the first suit free, and all renewals at cost price; payment being arranged in instalments to suit the means of the Cadets.

7. Apprentices possessing the qualifications and standard of attainments required of students of the Technological School at Mt. Clare, Baltimore, and all Cadets, are entitled to enter that institution. Students of the Technological School, either of whose parents have been in the employ of this Company for five consecutive years, are entitled to free tuition and use of text-books and apparatus. Other students, sons of employes, of less than five years' service, are entitled to free tuition in the first class, and to tuition in the second and third classes at half the rates fixed for other students by the regulations of the Technological School. Apprentices and Cadets appointed outside the service, while under pay from the Company, will be charged full tuition fees for instruction in the Technological School.

8. Apprentices or Cadets of one class can, in the discretion of the General Manager, be promoted into a higher class before the expiration of the full term of their respective classes, on the certification by the Corps of Instructors of the Technological School of their having satisfactorily passed examinations entitling them to such promotion. Such examinations shall be graded, and those of higher grade shall first be promoted. But no Cadet officer will be graduated until he shall have taken the full course of instruction of the third class.

9. In filling vacancies in the second class, other things being equal, preference will always be given Apprentices, in order of merit, over other outside applicants for such cadetships.

10. No appointment shall be made in the grade of Cadet Officers except from Cadets of the second class, in the order of merit, as certified by the Corps of Instructors.

11. On the completion of their courses, members of the several classes will be entitled to a final examination by a Board composed of members of the Corps of Instructors and Railroad Officials appointed for this duty by the President of this Company, and upon passing satisfactorily such final examination, will be awarded diplomas setting forth their qualifications and entitling them to preference over all other applicants not thus graduating, in appointments to the higher classes or in filling vacancies in positions of responsibility in the gift of this Company, as they may elect, and as the Board may recommend.

12. Regular attendance upon the sessions of the Technological School is obligatory upon all Cadets and upon all Apprentices located at Baltimore as the Board of Examiners may determine are fit to enter the School, and they will be equally amenable to the discipline and regulations of the School as to those of the Company.

13. Students at the Technological School will have the privilege of purchasing, in small instalments, such of the tools, implements and text-books used in the course of instruction there as they may desire and as may be deemed useful to them after graduation.

14. Apprentices and Cadets are required to become members of the Baltimore and Ohio Employes' Relief Association, the same as other employes, and are entitled to all the privileges of its Savings Fund and other features.

15. Through the Free Circulating Library at Mt. Clare, Apprentices and Cadets residing outside of Baltimore can obtain the free use of text-books and apparatus to enable them to follow the course of the Technological School.

APPOINTMENT OF APPRENTICES AND CADETS.

SECTION II.

1. Apprentices and Cadets are not bound by indenture, but those who complete satisfactorily the terms for which they are engaged will be given certificates of general character and ability.

2. The number of Apprentices and Cadets will be regulated by the General Manager, who, under these regulations, will have the exclusive appointment thereof and

their assignment among the various departments and stations of the service. All applications for appointment should be addressed to him.

3. Other things being equal, preference in appointments will be given sons of employes of long and faithful service, and especially the sons of employes killed or disabled in the service. To enable the sons of employes to enjoy this privilege to its fullest extent, free transportation from points on this Company's lines nearest their homes, to the place of examination and return, is offered them; candidates paying their own travelling expenses.

QUALIFICATIONS OF CANDIDATES.

SECTION III.

1. Candidates for admission to the first class must be between 15 and 21 years of age, and to the second class between 17 and 22 years of age.

2. Candidates must, at the time of examination, be physically sound, of robust constitution, and generally free from any deformity, hereditary or acquired tendency to disease or infirmity which may render them unfit for the active service of this Company.

3. Candidates must be well versed in reading, writing, including orthography, in arithmetic, and have a knowledge of the elements of English grammar, and of descriptive geography, and of the history of the United States.

4. Candidates will be examined: *first,* by two Medical Examiners of the Relief Association, whose decision as to their physical qualifications shall be final; *second,* by one or more instructors of the Technological School, whose decision as to their educational qualifications shall be final.

5. The Examining Boards will meet at Mt. Clare Station, Baltimore, on the first Monday of each month, when there are candidates for examination. No candidates will be allowed re-examination within three months of last rejection by either Board.

6. Candidates who pass the physical and educational examinations will be required to become members of the Baltimore and Ohio Employes' Relief Association.

[An illustration of the character of examination which applicants for apprenticeship will be expected to pass is appended to this order.]

SECTION IV.

1. In the order of seniority of examination, and as vacancies occur, candidates will be assigned to probationary duty in the particular branch of the mechanical or other operating department in which, through inclination or aptitude, as determined by their examination, they are most likely to succeed.

2. At the expiration of six months they will be re-examined, and those passing will receive warrants of appointment, and will be assigned to the respective classes their qualifications entitle them to enter. Those found to be especially advanced or apt will, with their consent, be detailed to duty at the Company's works, Mt. Clare, Baltimore, where, in the Technological School, they will have special opportunities for technical instruction.

SECTION V.

A Board for the examination and classification of all Apprentices now in the service is hereby convened. Messrs. —— —— and —— —— are designated as the members of the Board to conduct the examination as to educational qualifications, and the Secretary of the Relief Association will detail two Medical Examiners to serve thereon. The Board as thus constituted will immediately enter upon its duties.

The Board of Examiners will convene on the first Monday of each month at Mt. Clare, Baltimore, for the examination of candidates ordered before it by the General Manager. As the finding of this Board will be final, and as a sound body and constitution, good natural capacity and aptitude for study, industrious habits, perseverance and an orderly disposition, together with a correct moral deportment, are essential qualifications, candidates knowingly deficient in any of these respects should not subject themselves and friends to the chances of future disappointment by entering upon a career which, lacking these qualifications, they cannot successfully pursue.

B. DUNHAM, *General Manager.*

ILLUSTRATION OF CHARACTER OF EXAMINATIONS.

SECTION VI.

PHYSICAL EXAMINATION.

Every candidate will be subjected to a rigid physical examination, and if there is found to exist in him any of the following causes of disqualification, to such a degree as would immediately, or at no distant period, impair his efficiency for the active service of this Company, he will be rejected:

1. Feeble constitution and muscular tenuity; unsound health from whatever cause; indications of former disease; glandular swellings or other symptoms of scrofula.
2. Chronic cutaneous affections, especially of the scalp.
3. Severe injuries of the bones of the head; convulsions.
4. Impaired vision, from whatever cause; inflammatory affections of the eyelids; immobility or irregularity of the iris; fistula lachrymalis, etc.
5. Deafness; copious discharge from the ears.
6. Serious impediment of speech.
7. Want of due capacity of the chest, and any other indication of a liability to pulmonic disease.
8. Impaired or inadequate efficiency of one or both of the superior extremities on account of fractures, contraction of a joint, deformity, etc.
9. An unusual excurvature or incurvature of the spine.
10. Hernia.
11. A varicose state of the veins of the scrotum or spermatic cord (when large), sarcocele, hydrocele, fistulas.
12. Impaired or inadequate efficiency of one or both of the inferior extremities on account of varicose veins, fractures, malformation, permanent lameness, contraction, unequal length, etc., etc.
13. Ulcers, or unsound cicatrices of ulcers likely to break out afresh.

EDUCATIONAL EXAMINATION.

The following outline, problems, and questions are given as illustrating the nature and scope of the educational examinations. While these illustrate the character of the examination, it should be distinctly understood that different questions will be used at each examination. The examinations will be part written and partly oral.

ARITHMETIC.

(*a*) Fundamental rules, with methods of proof and reasons for processes.

(*b*) Factoring: G. C. D. and L. C. M. and their applications; common and decimal fractions, their kinds, solution, and reduction from one to the other, with both the rule and the *reason* for each operation.

(*c*) Denominate numbers; tables; reduction, ascending and descending; changing denominate numbers to equivalent decimals.

(*d*) Ratio and proportion, their kinds, methods and applications.

(*e*) Mensuration of lines, surfaces, and solids, and their representation by drawings.

(*f*) Percentage and its applications.

(*g*) Involution and evolution, and their applications.

(*h*) Analysis of mental problems.

Illustrative Problems and Questions.

1. Write in figures one hundred and sixty billion three million seventy thousand and five. Write in words 246004050. Write in Roman numerals 40, 90, 144; and in Arabic numerals L, XIV, LIX, CVIII and DCCLXXV.

2. Add two and five-tenths, eighty-six thousands, twenty-four ten-millionths and 3-tenths, multiply the result by .0002, and divide the product thus obtained by .00004.

3. Find the cost of 20 acres, 3 roods and 30 perches of land at $62.50 per acre.

4. A man sold $24\frac{7}{8}$ bushels of wheat at $$2\frac{5}{6}$ per bushel, and received in payment apples at $$3\frac{3}{4}$ per barrel. How many barrels of apples did he receive?

5. Reduce 6 furlongs 20 rods to decimal of a mile.

6. Reduce .0256 to a common fraction and $\frac{5}{16}$ to a decimal.

7. Add $\frac{7}{8}$, $\frac{7}{10}$, $\frac{11}{12}$, $\frac{3}{4}$, and divide the result by $\frac{5}{8}$. Also reduce to its simplest form $\frac{6\frac{1}{4}+2\frac{3}{8}}{\frac{4}{7}}$.

8. Define fraction, common fraction, decimal fraction, proper fraction, mixed number, division, greatest common divisor, least common multiple, cancellation, long division, and denominator.

9. Find the prime factors of the following: 256, 312, 63, 280, 289, and 1386.

10. Divide the least common multiple of 240, 720, and 150 by the greatest common divisor of the same number.

11. Find the interest on $240 for 3 years and 6 months at 8%.

12. How must I sell cloth that cost $4 per yard so as to gain 20%?

13. A and B together have $540, and A has twice as much as B. How much has each?

14. $\frac{3}{4}$ of 24 is $\frac{3}{8}$ of what number?

15. What number divided by .024 will yield a quotient of .25? Prove.

16. Find the area and hypothenuse of a right-angle triangle whose base is 240 and altitude 75.

17. How many men would be required to cultivate a field of $2\frac{5}{8}$ acres in $5\frac{1}{2}$ days of 10 hours each, if each man completed 77 square yards in 9 hours.

18. If 5 cubic feet of gold weigh 98.20 times as much as a cubic foot of water, and 2 cubic feet of copper weigh 18 times as much as a cubic foot of water, how many cubic inches of copper will weigh as much as $\frac{3}{5}$ of a cubic inch of gold?

19. What is the effect of dividing the denominator of a fraction by a whole number, and why.

20. What is the effect of annexing a cipher to a decimal, and why?

21. If the same number be subtracted from both terms of an improper fraction what will be the effect? Why?

22. Give the rule for reducing a common fraction to an equivalent decimal, and explain why the resulting decimal will be equal to the common fraction from which it is obtained.

23. Give the rule for dividing one decimal by another, and explain why the decimal point in the quotient is placed where the rule directs.

GRAMMAR AND ITS APPLICATIONS IN CONVERSATION, IN LETTER WRITING, AND IN COMPOSITION

Outline.

(*a*) The parts of speech, with their properties and inflections.

(*b*) Analysis of ordinary simple, complex and compound sentences, and the fundamental relations of subject, copula, predicate, object, etc.

(*c*) Punctuation, capitalization, spelling, etc., in original composition or from dictation.

(*d*) Corrections of improper use of words, constructions and sentences, in ordinary conversation, and in composition and letter-writing.

Illustrative Exercise in Grammar.

1. Name the parts of speech and define noun, abverb and conjunction.
2. Name the properties of the noun; of the verb.
3. Decline boy, he, it and who.
4. Conjugate the verb to throw in the indicative mood, past tense, passive voice.
5. Write the plural of lady, turkey, this, that, box, house, potato, mouse, sheep and father-in-law.
6. Name the relative pronouns and compare good, little, old, happy, big, thin and likely.
7. Parse all the words in the following sentence: The birds sing merrily in the green trees.
8. Correct the following and give reasons:

(*a*) Him and me will come.

(*b*) He saw John and I in the garden.

(*c*) Who did she marry?

(*d*) Between you and I there is but little difference.

(*e*) I laid down and slept because I was to tired to sit up.

9. Capitalize, punctuate and correct the following sentences:

(*a*) the Groves were gods first temples

(*b*) when will You and i get there

(*c*) john left New york i cannot tell when he will git Home.

(*d*) John, and me and James went to school. at Boston last winter. We got home on thursday.

10. Write a description of this room and its furniture. Be careful to capitalize and punctuate correctly.

GEOGRAPHY.

1. Give the distance in miles around the earth; also the length of its diameter. How wide is the Atlantic Ocean? How far would you have to travel in going across the United States from east to west? from north to south? When you do not know the exact answer, put down about what *you think* would be the correct answer.
2. Name the grand divisions in order of their size; of their population. Where do the most highly civilized nations live?
3. Bound Europe and name five of its principal rivers, telling where they rise and empty. Also name and locate five of the principal cities of Europe.
4. Name the principal mountain systems of Asia; of Africa; of South America.
5. Name the States of the United States that border on the Atlantic, and give the capital and metropolis of each. Also name the largest State of the United States the smallest; the most populous.
6. Give the leading products of Georgia; of California; of Pennsylvania; of Illinois.

7. Locate the following and tell what they are: Sahara, Washington, Columbia, Portland, Blanc, Nile, and Mexico.

8. Bound the United States, and give its area and population.

9. Name the political divisions of South America.

10. Write fifteen lines about Africa.

11. Bound your native State, giving its capital, metropolis, and principal products.

12. How are United States Senators elected, and for how long a term?

UNITED STATES HISTORY.

Outline.

(*a*) Aborigines of America.
(*b*) European settlements, when, where, and by whom.
(*c*) Colonial history, and inter-colonial wars.
(*d*) American Revolution, its remote and immediate causes and results.
(*e*) Constitution, why and when adopted; its departments and powers.
(*f*) The Presidents and events of their administrations.
(*g*) War of 1812; Mexican War; Civil War.
(*h*) Current events.

Illustrative Questions.

1. Tell something about Columbus, stating where and when he lived, what he discovered, what voyages he made, etc. What do you think of the treatment that he received?

2. Name the different European countries that tried to get possession in America, and tell which three were the most successful.

3. Give an account of the French and Indian War, telling what it was about and how it terminated.

4. Write thirty lines about the American Revolution, telling its cause, naming five principal battles, three generals on each side, etc.

5. What was the Declaration of Independence? Who wrote it?

6. Name the Presidents of the United States and give the leading events of Jackson's administration.

7. Tell something about Franklin, Wolfe, Morse, Fulton, Longfellow, Emerson, Arnold, and Alexander Hamilton.

8. What cities have been the capital of the United States?

9. What happened in 1492? 1565? 1607? 1620? 1776? 1876?

10. How long did the war of the Rebellion last, and during whose administration did it take place? State the provisions of the Fourteenth and Fifteenth Amendments.

11. What is the objectionable feature of Mormonism, and what measures have been advocated in Congress to eradicate this evil?

12. What event is there talk of celebrating by an International Exposition at Washington in 1889? In 1892?

13. What is the use of International Expositions?

NOTE.—It is suggested to candidates for admission to the Corps of Apprentices and Cadets that, before leaving their places of residence, they should cause themselves to be thoroughly examined by a physician, and by a teacher or instructor of good standing. By such examinations any serious physical disqualification or want of educational preparation would be revealed, and the candidate spared the expense and mortification of a useless journey and rejection. But it is to be understood that such examination is solely for the convenience and benefit of the candidates, and in no manner affects the decision of the Official Examiners of the Board.

EXHIBIT V.

BALTIMORE AND OHIO TECHNOLOGICAL SCHOOL.

[Circular No. 1.]

BALTIMORE, *October 1, 1885.*

In view of the necessity of postponing for the present the initiation of the Technological School program in its entirety, the present course of instruction will be conducted with special reference to its practical utility:

First. In advancing the entire force of apprentices within reach of its influence in their several mechanical pursuits; and

Second. In advancing the theoretical instruction, as far as may be practicable with the limited appropriation at command, of such apprentices as past examinations have shown possess sufficient common-school education to justify the hope that they can, without additional school-training in academic studies, qualify themselves for positions as officers in its service. So far as may practicable, the work of the school shall have a direct bearing upon, and immediate connection with, the various duties in the shop with which the apprentices are or may be charged. To this end the technological and academic instruction will be carried on under separate instructors, each responsible for the conduct and success of his particular department, and each reporting to the undersigned, as representing the Board of Directors of the Technological School.

ASSIGNMENT OF MR. C. W. SCRIBNER, AS TEACHER OF TECHNOLOGY.

To Mr. C. W. Scribner, as a specialist in technology, and as senior instructor, is assigned charge of the practical instruction of apprentices in the shops and drawing-room. He will be at liberty to maintain such separate class-instructions in purely technical subjects as he deems necessary to promote the interests assigned him, and will not interfere with the apprentices' shop and academic duties. In the performance of this duty he will spend not less than six hours per day in the shops, and not less than two additional hours in the drawing-room, and in such class-instructions as he may inaugurate, Sunday excepted.

HIS DUTIES DEFINED.

His duties as technological instructor will consist:

First. In exercising a general supervision over apprentices in the shops and in applying their theoretical knowledge to their labors.

This duty will be performed in accordance with a plan to be agreed upon between the instructor and the several foremen; which plan must be of such character as will give the instructor proper facilities for overseeing and directing the labors of apprentices, so far as they are learners, and to question and counsel any boy or boys while at work, in order to determine their understanding of what they are doing, to make explanations and to direct their operations in such way as to enable the apprentices to gain comprehensive and practical knowledge of the scientific principles involved in what they may be doing.

SEPARATE AUTHORITY OF THE INSTRUCTOR AND THE FOREMAN DEFINED.

In exercising this duty, the instructor will have no right or authority to antagonize or interfere with the orders of the foreman in charge, so far as they relate to the Company's work, nor to interfere with its proper performance; nor shall he, for the purpose of instruction or examination, unnecessarily, nor for any great

length of time, even when necessary, retard the work which the apprentices are doing. To prevent confusion in the Company's work, it is to be understood that the foremen have the undisputed right to decide what work is to be done by apprentices and when it is to be done; the recommendations of the instructor in the matter of the assignment of apprentices shall be made first to the foremen, and shall be carried out by them unless they are clearly in conflict with the interests of the service. In each case where the instructor and foreman fail to agree, either in formulating the plan for the joint management of apprentices or upon the proper interpretation and scope of this arrangement, the question or dispute shall be referred to the Master Mechanic or Master Car Builder, to whom the foreman reports, and if he cannot satisfactorily adjust the difference, the whole matter will be referred to the General Manager for settlement.

The foregoing applies to all apprentices at Mt. Clare shops.

Second. A certain number of hours per week, not fewer than three, shall, by agreement between the instructor and foremen of the various shops, be set aside, in which the technological instructor shall assemble the apprentices of the first class for the purpose of explaining the scientific principles that are involved in the work on which they are engaged, of suggesting and illustrating the most economical methods of work, of showing how different parts of machinery are put together, and of pointing out the office of each part. He shall explain why some other way of constructing or doing such work would not do just as well, and be as economical as the way he suggests. He shall point out difficulties that are yet to be overcome in the construction and operating of machinery, and, in short, make the instruction of such a character as to set apprentices to thinking and devising for themselves. He shall also give instruction on the nature of the materials, and in the use and care of tools and machinery.

In the performance of these duties he shall have authority to utilize the machinery in the shops where the same is not in use.

The technological instructor shall study the machinery and methods of work now in vogue in the shops, and shall make recommendations to the foreman or to the Master Mechanic or to the Master Car Builder, as the case may be, of any improvements in the method of work, in tools, in machinery, or anything that in his judgment will increase the efficiency of the shops.

He shall also study the shop-work with a view of recommending to the undersigned what academic subjects might be taught in the school, and the best methods of teaching them with a view of their immediate application in connection with the shop-instruction.

He is expected to study and make note of the capabilities and the aspirations of the various apprentices, and the joint recommendations of the instructor and the foreman to the General Manager, through the intermediate officers, as to the aptness, progress, skill and commendable traits of any apprentice, shall determine whether his apprenticeship shall continue for a longer or shorter period than the usual time prescribed (four years); but no boy whose standing in the school-studies is habitually low shall have the time of his apprenticeship reduced to less than the usually required four years, however expert he may become in the shop.

The shop-instructor shall, during the academic year (being guided by his experience and observations in the shops), make a classification of the regular kinds or pieces of work which are constantly required to be done in the shops, and on which apprentices should have practice, and arrange them in the order in which it is best to have apprentices take them up in learning their trade, submitting the same to the Master Mechanic and Master Car Builder.

He shall also, during the academic year, outline methods of instruction and recommend the academic studies that, in his judgment, are most suitable for the apprentices of each trade, and for the students of civil and mechanical engineering,

with a view to preparing a permanent program and prospectus for the succeeding year.

In all matters relating to the school he will report direct to the undersigned.

ASSIGNMENT OF MR. COLER, AS THE ACADEMIC TEACHER.

To Mr. Coler, is assigned charge of all academic studies, which will for the present be confined to the several sections of first-class apprentices.

Under this arrangement he will spend not less than eight hours per day in the discharge of his duties. Of this time he may devote one or two hours daily to the shops, in order to observe the needs of apprentices, the work and equipment of the shops, so as to make the school-instruction both practical and interesting, by drawing his illustrations in teaching as far as possible from machinery and operations in the shops where the boys are daily employed.

The academic department shall include three sections of apprentices. The first grade shall consist of all those who are qualified to meet the requirements of General Order No. 5 for admission to the first class therein mentioned.

The second section shall consist of such apprentices now in the service as may, with a reasonable amount of teaching, be qualified for admission to the first section.

The third section shall consist of all other apprentices whose time of apprenticeship does not expire before January 1, 1887.

All apprentices who receive academic insturuction (Sections 1 and 2) must take Drawing at least two hours each week. The technological teacher may also require apprentices who are not in these sections to take Drawing.

The subjects for academic instruction for the first class are Algebra, Geometry, and English and Elementary Science.

Apprentices who are preparing for admission to the first section are to be known as second-section students.

These shall take Arithmetic in addition to Drawing as required studies, and they shall choose a third subject from the following: History, Geography, English, Elementary Science, Steam and Steam Engine, and Mensuration.

Apprentices of the third section are required to take Drawing at least two hours per week. They may at any time enter either of the other preparatory sections, provided those sections are not already full, and provided they are qualified to profit by the instruction to be given in the class, which last is to be decided by Mr. Coler.

Students of the third section must attend the free city night schools nearest to their homes, and it shall be the duty of Mr. Coler to see that this requirement is fulfilled.

Each teacher shall make a weekly report of how much time he has spent in each shop and school-room, the character of teaching, results, etc.

Each to report directly to me, but to recommend jointly anything that relates to their two departments.

W. T. BARNARD, *Asst. to President.*

EXHIBIT W.

SCHOOL REPORTS

JANUARY 30, 1887.*

Dr. W. T. BARNARD,
Assistant to President:

DEAR SIR: In compliance with your request for a special report, showing what has been accomplished by the Technological School from its inauguration to the present date, I respectfully submit the following:

From the Circular of January 15, 1885, setting forth the management and policy of the school, and from your subsequent instructions, we have understood the purpose of the school to be threefold:

1. To maintain an educational examination as a condition of admission to apprenticeship, and to afford such elementary technical instruction to all apprentices as would make of them intelligent journeymen; the apprentice instruction to be known as the Journeymen's course; this course to be free to all apprentices, and to serve as preparatory for the Cadet course for young men whose ability and character are good, but who need preparatory training.

2. To organize a class of Cadets for advanced technical instruction in such subjects as bear upon the departments of railway service in which they are to engage; the object of this course being to fit young men to become foremen and for other subordinate positions; this class to be composed of apprentices or other young men who shall pass a required examination and present testimonials of ability and character; a reasonable tuition to be charged for this course.

3. To secure to the service as Cadet officers a limited number of young men possessing superior ability and educational qualifications, to whom thorough and comprehensive technical instruction should be afforded, while at the same time these young men should get a comprehensive and practical knowledge of the various departments of railway service and the mutual relations of these departments; the object of this course being to fit the students for the highest positions of responsibility in the service.

It is with these ends in view that we have been guided in the management of the school, and our plans have all along contemplated an early organization of the Cadet Class. With reference to the Cadet Officers' Class, we have understood that it was your policy not to admit young men to that course of study until they shall have completed the Cadet course and thus have demonstrated whether it will be profitable to the company to continue instruction to them. We have not, therefore, undertaken, except in a general way, to forecast the subjects of study and the management of that class.

That there are substantial reasons for the apparently slow progress we have made, and that we have nevertheless worked out results and gained experience that will be far-reaching in their economic value and otherwise beneficial consequences, providing it is thought best to continue the school, will appear from considerations and facts to be set forth in detail in what follows.

FAILURE OF APPLICANTS TO PASS EXAMINATIONS IN ELEMENTARY ENGLISH STUDIES.

In February, 1885, one hundred and forty-seven apprentices, then in the service at Mt. Clare, were examined by Mr. Scribner and myself, and in July and August of the same year Mr. Scribner and Mr. Sullivan examined about three hundred and fifty apprentices in the shops along the line. The results of these examinations

*Although my report is dated October, 1886, the last sections were unavoidably delayed, so that school reports of this date are inserted.—W. T. B.

went to show that not one of the five hundred boys and young men in the various repair and construction shops was sufficiently advanced to pursue technical studies with profit to the Company and to himself. We were greatly surprised that among so many boys there should be found such uniform deficiency in the most elementary school-studies. Combined with this lack of elementary knowledge was a corresponding lack of inclination on the part of these apprentices to make of themselves anything more than ordinary routine and rule-of-thumb mechanics. It must be evident that such apprentices will require constant supervision in even the simplest details of their trades, and that when they become journeymen they will be untrustworthy and unprogressive.

Thinking that perhaps a few of the most promising boys might, by receiving preliminary training in night-classes for six months or a year, be prepared for the more elementary technical studies, we determined to give them instruction in the rudiments of grammar-school branches. Having secured an order from the General Manager to this effect, we required about forty boys to attend night-classes from the first of March to the twentieth of June, 1885. This was done with the hope that all might profit to a certain extent by the elementary instruction thus afforded, and that from these forty boys there might be a dozen or more who would work their way up so as to profit by the technical course we had in view for apprentices; but a short experience convinced us that for the most of these boys the attempt was made in vain. Some would if they could; others could if they would. Only three out of these forty apprentices have made commendable progress in all the school-studies, though none of them are any the less valuable to the service for having been required to attend the classes, and several have done well in drawing in spite of their deficiencies in academic studies.

CAUSES OF THIS LACK OF ABILITY TO DESIRE TO LEARN.

It would be wrong to attribute the failure of these boys to advance in theoretical studies wholly to their inability or unwillingness to profit by the class-instruction that was offered them. It should be remembered that in addition to their not having previously formed habits of study—a fault of their parents and former teachers—these boys came from daily associations in the shops, the very atmosphere of which was discouraging to efforts for mental improvement; for the idea that a workman should pursue school-studies has almost invariably been ridiculed in the shops,—and ridicule is apt to dampen the ardor of students who have not advanced far enough in studies and experience to appreciate the importance of education. Moreover, the work of instructing apprentices was new to the teachers, and we made some mistakes, one of which was an attempt to put all boys through precisely the same kind of training without regard to individual aptitudes. I think, too, that the work at first attempted was too severely mathematical for apprentice studies. Dry, abstract mathematical drill will not interest apprentice boys, nor make intelligent, thinking mechanics of them. With the exception of drawing, we did not succeed in giving the instruction enough of a tangible and practical bias to encourage boys to take an interest in our classes.

From my own experience and study of the subject since my connection with this school, and from the testimony of teachers and employers in Europe who have made similar attempts, I am convinced that while it is possible and desirable to educate apprentices in technical subjects during apprenticeship, even though the instruction be wholly confined to night-classes, it is equally certain that to try to educate boys who have not formed habits of study before entering upon apprenticeship is a useless waste of time, patience and money. Although there may be exceptions, the results are usually very meagre and unsatisfactory.

IMPROVEMENT OBTAINED.

Since March, 1885, there have been, in accordance with your plans and instructions, regular educational examinations every month, except July, 1886, of applicants for apprenticeship; and with two or three exceptions, no boys have been admitted to apprenticeship at Mt. Clare without first trying this examination. At first we had to make the standard of requirements very low, in order to get enough boys to supply the demand for apprentices; but there has been a gradual, though decided elevation of that standard, so that at the present time none can be admitted without a fair knowledge of the rudiments of elementary English branches; nor then without demonstrating some ability to think, and expressing a willingness to to avail of the school-instruction by regular and prompt attendance at the classes if admitted to apprenticeship.

CHANGES IN MANNER OF TEACHING; THE RESULT OF THIS EXPERIENCE.

As the result of these examinations, we had, when the school year began in October, 1885, about thirty apprentices capable of pursuing more advanced studies. Guided somewhat by our experience the preceding term, and profiting by observations that I had made in the management of workingmen's and apprentice schools in Europe, we made some decided changes in the subjects and methods of instruction. Classes were formed in drawing, in mathematics, in the study of the locomotive engine, and in physics. Instruction was also given in English and in history, and a few classes were still sustained for the elementary instruction of the forty boys who had been in the school the previous term. These classes, with some changes and additions, were sustained during the school year ending in June, 1886, and about eighty different boys, more or less advanced, received instruction during that year, all of whom were required to take drawing and to choose at least two academic studies. In addition to the general class-instruction, boys were encouraged to read many books on general and technical subjects, and a few of them were induced to take an interest in the scientific and mechanical journals which come regularly to our library. We also had a number of science lectures illustrated by simple experiments. These exercises proved both interesting and instructive to the boys.

For a more complete and detailed statement of the academic work undertaken, and which with some modifications was carried out in the school year ending June 1, 1886, I respectfully refer you to my report of October 9, 1885, a copy of which I hand you herewith.* But the work accomplished by the school for that year was by no means confined to academic studies and class-instruction.

It has been our constant endeavor to carry the instruction beyond the schoolroom into the shops, after the manner set forth in your school circular of October 1, 1885. [Exhibit V.] Owing to difficulties which are obvious and inherent to such an undertaking, our progress in this direction has been slow. Something has been done, however, in the way of supervision and systematic instruction of apprentices in the shops, and our experience in this direction I regard as invaluable, so far as it has gone.

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* MT. CLARE, *October* 9, 1885.

DR. W. T. BARNARD,
Assistant to President.

DEAR SIR: The following is the course of academic study which I have marked out for the present school year. It contemplates two terms—one to end February 1, and the other at the close of the school year. I have arranged the course with reference to the three classes of apprentices indicated in your school circular of October 1 (Exhibit V):

1. Those in the First Section of the regular technical course—First Term: Algebra, Physics, Steam, the Locomotive Engine, and Drawing. Second Term: Practical Geometry, Physics, English, and Drawing.

SURPRISING IGNORANCE OF TECHNICAL FACTS SHOWN BY YOUNG WORKMEN.

Investigations in the shops by conversations and observation have developed the fact that many boys and young men had completed or almost completed their apprenticeship in the machine-shops without being able to tell the difference between cast and wrought iron, without knowing whether steel is a native or manufactured product, and equally ignorant of many other simple though important and significant facts which are intimately related to their trades.

In the performance of his specified duties as shop-instructor, Mr. Scribner made a study of the various trades, machines and processes in the shops, and of the successive steps in apprenticeship, with a view to recommending a course of shop-instruction that would be parallel to the theoretical studies taught in the school. By short, pointed conversations with the boys while at their machines, which did not at all interfere with the work they were doing, the shop-instructor was enabled to set boys to thinking intelligently about the machines and the work upon which they were engaged. In this way the class-room instruction could often be imme-

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2. Those who are not now prepared for the First Section, but may be so prepared with a reasonable amount of teaching and encouragement.[1]

First Term: (1) All required to take Drawing one night each week. (2) Each boy required to choose two studies from the following: Arithmetic, History and Geography, Elementary Physics, Steam, the Locomotive Engine, and English.

Second Term: About the same as First.

3. Apprentices who were not likely to be able to prepare for advanced studies. These were to be required to take Drawing one or two nights each week at Mt. Clare, and to attend the city night-schools.[1]

In justification of our attempt to introduce technical studies with so little preliminary preparation on the part of students, I would call attention to the following considerations:

1. That in English schools boys with no better elementary education than many of our boys possess, study these subjects in night-schools after working all day, and some of them pass the Government's examinations in science, and the City and Guilds of London examination in technology, with honor.

2. These studies will produce just as good, if not better, educational results, and have more practical value, than the study of the ordinary elementary school-branches.

3. The study of elementary science experimentally illustrated, as we intend it shall be, will do much toward awakening an interest in, and showing the utility of, more abstract studies, and the boys will learn more mathematics with the science studies then they will without them. The science studies will also go far toward creating an interest in the scientific and mechanical books and papers that are in our library, and prepare the boys to profit by such reading.

At first thought, it may not seem so desirable to have science taught to apprentices as drawing. The drawing produces visible results and its value is therefore much more readily appreciated. But if we had some graphic method of representing the results of science-teaching—the habits of thought, observation, intelligent inquiry, and definite expression that are thus developed—I believe the vote of those concerned would be to continue the science-teaching along with the instruction in drawing.

4. It cannot reasonably be expected that the progress in study by apprentices who work all day in the shops will be anything like as perceptible and efficient as is the progress of young men in such schools as the Massachusetts Institute of Technology, where only a few hours each week are devoted to shop-work. But by choosing such science studies as have the most direct bearing upon the work in the shops, and pushing these studies, some progress can be made. While we will not give as much *theory* as is given in other schools, we will give much more *practice*, and our present system of shop-instruction contemplates an immediate application of theory, whereas much of the theory in other schools is never applied. I believe that, so far as the interests of the employer are concerned, more good will result from a technical school in which *practice* predominates over theory, than in one where the reverse is true. A school as such looks for the highest good in each boy, and this is right; but in such a school as we are seeking to build up, the problem is how to make the instruction of such a character as to justify the employer in maintaining the school. This, I believe, can be done by carrying the instruction not merely up to the shops, but *directly into them*. Yours truly,

G. P. Coler,
Instructor in English and History.

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[1] It was found later that this was impracticable. As before stated, experience soon showed that it was useless to waste time on boys who had not previously formed some habits of study, and so many boys were coming into the service under the provision of the educational examination that it was decided to devote all the time and resources of the school to their advancement.—G. P. C.

diately applied, and apprentices were directed to books and mechanical journals where they could get still further knowledge.

Mr. Scribner also took groups of boys from machine to machine and from shop to shop for the purpose of studying machinery and mechanical processes in detail and in their relation to each other. Attention was called to the uses of the machines and the scientific principles involved in their construction and operation, and one class of advanced boys were thus permitted to supplement their class-room study of the locomotive engine by seeing its parts and the successive steps of its construction.*

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*(The following extracts from reports of Mr. Scribner, who was principal of the school till June, 1886, will afford a general idea of the work that was attempted in the way of shop-instruction.—W. T. B.)

MT. CLARE, *November* 28, 1885.

DR. W. T. BARNARD,
Assistant to President.

DEAR SIR: My time at Mt. Clare has been taken up much as during the week previous, a rather large share being still required for Drawing, as will be the case until we are well started. We organized an advanced class of those who have had Drawing before coming here, selected from our Wednesday and Tuesday afternoon classes. These are to take up Descriptive Geometry, and will meet for the present on Friday afternoon at 3 o'clock. Every member of the school, some seventy-five in all, is now having one lesson weekly in Mechanical Drawing, the First Section meeting for three hours in the afternoon, and the other sections for two hours, at night only. The progress this week has been even more satisfactory than last week, and as soon as we get our instruments and some other necessary equipments, the Department of Drawing will be fairly on its feet. In the shop I continued the instruction on the locomotive, taking another set of boys, and expect to be able to do still more of this work next week.

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Besides the shop-instruction I have during the past week turned my attention especially to that part of our present program [Exhibit V] which refers to studying "the capabilities and aspirations of the various apprentices," beginning with those who constitute our First Section. I spent some time in talking with each personally, and find that by calling their attention to the real purpose of their coming here, and the means they must use for their own advancement, it is always possible to arouse greater interest in their shop-work and their studies. Another result of such questioning is to point out the need of instruction in special subjects which are very important.

As an example of this, I found that some very intelligent apprentices had no very clear idea of the difference between *wrought* and *cast iron*—a knowledge which is essential to progress and efficiency in shop-work. Of course, even with no instruction whatever, they could not remain in the shops very long without getting some notion of this difference, and in certain very practical directions a far better idea, perhaps, than any one has who has never worked in a machine-shop. Yet it is manifest that clearer and truer notions on such subjects than can be picked up in the shop are needed, even at the outset, and will prove invaluable to them as they go on in their work.

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Another point which I have taken up this week is referred to in our program in these words: "The shop-instructors shall make a classification of the regular kinds or pieces of work which are constantly required in the shop," etc. Here I have commenced where our apprentices begin, at present.

The regular arrangement has been to have them spend a long time at first in turning out the *bolts* used in various parts of the locomotive and elsewhere. I have obtained from the Drawing-room special information about the kind and number of these bolts—some 700 in the ordinary locomotive—and upon the necessary work which these bolts require, in the machine-shop, I propose to formulate such a course of instruction as will make the work at the "bolt-lathes," which some boys now find tediously long, a source of interest and usefulness by giving them distinct ideas about the uses of these bolts the sort of finish they require, and the quickest and best ways of making them. This will be, it is true, an experiment, but a little study shows it quite possible; for the great variety of uses for these bolts calls for different degrees in the nicety of fit and finish to be given them, and this should exercise the boys as to the time each should have, although at first this cannot, of course, be left wholly to them. And then, if their attention is called to it, the very variety referred to is itself of value, illustrating the many uses of "the bolt." So, too, with other parts of our program that have special bearing on the work of this particular shop, practical methods of work can be outlined. Meanwhile, I need not neglect the other shops, though for particular attention they will have to wait their own turn.

Very respectfully submitted.

C. W. SCRIBNER,
Principal.

SHOP INSTRUCTION SUGGESTED.

It seems to me that judicious and systematic shop-instruction will do more toward bringing about visible economic results than any other feature of the school. I am firmly convinced that it is possible to arrange parallel courses of instruction for the school and for the shops of such a character that the shop-work will create and intensify interest in school-work and *vice versa.*

In the management of the Mt. Clare school we have endeavored to get boys interested in reading the history and development, and in knowing something of the present status of their several trades and industries. It is reasonable to expect the workers of iron and steel to have some knowledge of the history of the iron and steel industries; that electricians should know the past, present, and prospective future of electricity; also, that engineers should know about the history of the steam engine and the various steps in the invention and improvement of it. This method of special historical study and investigation, of industrial subjects will serve the two-fold purpose of promoting intelligence and stimulating and directing

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MT. CLARE, *December* 19, 1885.

DR. W. T. BARNARD,
Assistant to President.

DEAR SIR: With reference to organization of shop-work, I have, during the hours not spent in individual instruction, been working on three different lines: (1) In arranging pieces of work made into a shop-course; (2) In arranging a definite agreement with foremen; (3) In determining the way in which instruction in the use of tools can best be given in our shops.

On the latter point I find that much time is used to small purpose if I talk to apprentices separately on this subject, instead of to classes. I have, therefore, decided that, while I can continue this to some extent, my best plan will be to teach in small classes wherever possible; this plan also making the use of a fixed system much easier. To this end the two points first named relate. And (1) the cataloguing of standard shop-pieces has been continued, and I purpose to have sketches of them arranged in a book, noting on the page opposite the name and use to be made of each piece, the machine-tools to be used in fitting it up, the various cuts to be made and the cutting-tools to be used with each machine-tool. This done, they can be classified into several parallel progressive courses; and though all this consumes time, it will in the end save far more by securing a working system so arranged as to give better instruction, to several boys at a time—unquestionably a better plan than to give individual instruction only. But all this would avail little, if each piece used as an exercise had to be done *only* under orders from the foremen, to be rushed through when time could be ill afforded for requiring the boy's attention to the form of his cutting-tool, and for explaining the reason why each part should be shaped as it is, or perhaps at a time when the instructor could not be presen ; in either case merely verbal directions and no working drawings being furnished. But while convinced that to work in this way I must have sole control of certain machines at certain hours, and of the work to be done on the "instruction-pieces," I was not first to suggest it, as I had to be sure that such a plan would not delay the work; and while one clause of our shop program gives the instructor the use of idle machinery, another states that "the foreman shall have undisputed right to say what work shall be done by the apprentices and when it shall be done," and that the instructor's recommendations in such matters shall be made first to them. I am glad to say, therefore, that such recommendations as I have made have been followed, not as yet by the foreman's enforcing them, but by his suggesting, himself, that it would be much better and simpler to detail certain machinery at certain hours for instruction-purposes, fully assenting to the value of a fixed course of teaching when done in this way on selected pieces to which time could be given. I then proposed this plan to the Master Mechanic, who not only at once assented, but said he felt sure that this method would give the best results, and was in fact the only one to follow. And now, since this proposition has come from the shop, I can feel sure that it is the most practicable for us, and the most practical, too, at least in the sense of giving satisfaction to all.

I referred above to the fact that the boys used no drawings. I now intend that all this special work shall be done from drawings exclusively, and later on the boys can work from drawings which they have themselves made in the school—not, of course, their designs, but made by them from measurements of the finished piece and approved by the head draughtsman of our works. Thus all boys so trained will be able to do all their work from standard shop-drawings, whenever such a system shall be brought into more general use in our shops than is at present the case.

Very respectfully submitted.

C. W. SCRIBNER,
Principal.

invention. The workman who has inventive genius will be much more likely to develop it and to avoid wasting his time on what has been already worked out, if he knows what has been done in past ages in the field of his specialty.

LACK OF APPROPRIATE TEXT BOOKS AND LITERATURE.

One of our great difficulties is to find books that will furnish both interesting and profitable technical reading for boys who are to become railway mechanics or operatives. A literature for apprentices needs to be written. Another hindrance to our work is the absence of text-books bearing on railway industries. The efficiency of any industrial school is dependent upon the adoption of text-books to the purpose for which the school was established. Our teachers have had to work up new subjects for class-instruction, and they often feel the need of text-books on these subjects. If such schools become common, suitable text-books will no doubt be forthcoming from enterprising publishers.

SUGGESTIONS AS TO METHODS OF INSTRUCTION.

Instruction for apprentices must at first deal with things immediately around them and proceed from these to things more remote and general. I am quite certain that the way to success in such a school as we want to establish at Mt. Clare for regular apprentices, and even for Cadets, lies not so much in the class-room drills, valuable as these may be made, as it does in each teacher's ascertaining the special aptitudes and inclinations of the different boys, and then, when that aptitude runs in the direction of the teacher's specialty, in its being developed to the highest possibilities by class-instruction, by a judicious course of reading, by shop practice and instruction, and by personal influence in conversations and otherwise, of the teachers upon the students.

GOOD RESULTS OBTAINED BY METHODS USED.

With reference to what the school is accomplishing this year, I am glad that I can report satisfactory results, considering the disadvantages under which we are compelled to work. As the result of the educational examination and the inducements which the Technological School offers to aspiring boys and young men, we now have at Mt. Clare, in the shops and enrolled in the school, about seventy apprentices whose ability is good and whose early education has not been wholly neglected. Instruction is given in Drawing, Descriptive Geometry, Physics, Mechanics, Algebra, and Geometry. There is a strong demand for classes in Steam, the Locomotive Engine, Mensuration, and other technical subjects, as well as the systematic shop-instruction, but the limited fund at our command prohibits the employment of teachers for these classes. For the advanced instruction that is now in progress I may refer you to the reports of the Instructor in Drawing, and of the Instructor of Mechanics and Physics, both of which are enclosed herewith. In addition to the class-instruction, books are given out to be read and reported on, and attention is frequently called to the mechanical journals on the library table. Some of the boys draw back numbers of these journals from the library in order to read them at their homes. It is our purpose to continue the illustrated lectures on scientific and mechanical subjects. These occur every week or every two weeks, and at the close of the lectures opportunity is afforded for asking questions and discussing the points that have been presented. Students and other employes at Mt. Clare attend these lectures. Occasionally a half hour after the lectures is spent in a social way, so that teachers, students and visitors are enabled to become acquainted. In this way much is done toward begetting a feeling of

esprit de corps on the part of all who are present. Although, on account of the pressing demand for new engines, many of the apprentices are this year required to work in the shops from two to four nights each week, our classes have, nevertheless, made commendable progress in their studies—their advancement and interest this year being by far the most satisfactory to the teachers, of anything that has been known since the school was organized.

DESIRABILITY AND ATTRACTIVENESS OF SUCH SHOP INSTRUCTION DEMONSTRATED.

The fact that boys of ability will enter the shops to get a trade and an education at the same time, and that they can and will learn under circumstances so discouraging as those resulting from our limited facilities for instruction and from the requirements of night-work in the shops, goes to show the desirability and the economic value of school-instruction in connection with workshops.

That progress in school-studies was at all possible under such circumstances is to be attributed to the superior ability and praiseworthy perseverance of the apprentices that have lately entered the service.

Many of these young men are soon able to do a journeyman's work and to increase the efficiency of the shops in numerous ways by their intelligence and quickness of perception. They are willing to accept apprentice wages for their services in order that they may advantage by our class-instruction. But I very much doubt whether we can hold the best of these young men unless they are afforded more instruction than they now have. Some of them are talking of going elsewhere to enter school, and I cannot blame them for their dissatisfaction with our present school facilities.

SUPERIOR CLASS OF APPRENTICES SECURED.

Of the young men who have become apprentices since the inauguration of the school, our records show that the number who have been at least two years in their several institutions are as follows: Baltimore City College, 5; other high schools, 7; McDonough School, 2; University of Alabama, 1; St. John's College 1; Johns Hopkins University, 1 (one year only); Naval Academy, 1; St. Louis Manual Training School, 1. Three boys have come from the Baltimore Manual Training School. A number of other boys have attended academies or good grammar schools, and not a few have come from the country. Although the previous school advantages of these country boys have not been very great, they are nevertheless among the most faithful and earnest workers in the Mt. Clare school and shops, and are making good headway in their school and shops.

We have constantly endeavored to do the most that could be done, with our limited facilities, toward advancing the individual interests of boys who have come here for the purpose of obtaining an education while learning their trades. But we have not lost sight of the fact that in a school of this character, sustained by a corporation in connection with its shops, the highest good should be looked for in the furtherance of the material interests of those whose money goes to pay for the instruction. Our efforts to make the instruction practical and, as far as possible, of immediate usefulnsss to the Company, have already been recognized and appreciated by some of the heads of departments. We have been asked to recommend young men for positions requiring intelligence and skill, and the demand for young men specifically qualified for certain positions is now greater than we can supply.

The educational requirements for apprenticeship have greatly improved the character and ability of apprentices at Mt. Clare. That industrial corporations should recognize the value of common-school training to such an extent as to make educational qualifications a condition of admission to their shops; for the purpose of

learning a trade, is an important movement in both education and industry. I would recommend that the monthly educational examination be extended, under the management of the school, to shops along the entire line. This can be done by sending the questions each month to the managers of the various shops, who should see that they are submitted to applicants for apprenticeship. The papers could then be sent to Mt. Clare to be looked over, graded, and returned to the proper authorities. The standard would of course have to be very low at first, but it could be elevated from month to month. The expense in this matter would be insignificant compared with the important economic results that could thus be attained.

WHAT THE SCHOOL HAS ALREADY ACCOMPLISHED.

In conclusion I will briefly summarize what has been accomplished by the school and its management since it was inaugurated:

1. The examination of 147 apprentices at Mt. Clare, and of 350 apprentices along the line, who were in the service when the school began.

2. The maintenance since March, 1885, of an educational examination as a condition of admission to apprenticeship at Mt. Clare.

3. The instruction in drawing and in elementary subjects of about forty apprentices who had been received into the service before the inauguration of the school.

4. The admission to apprenticeship of more than 100 boys, many of whom had already laid the foundation for technical training. Some of these young men do the work of journeymen, for which they are willing to receive very low wages on account of the school-instruction.

5. For more than a year we have been giving these young men the very best technical training in drawing, descriptive geometry, physics, mechanics and the locomotive engine, besides in the more general subjects of algebra, geometry, history, English, etc.

6. Our teachers, in their endeavors to make their instruction practical, have gone into the shops to study the machines, trades and manipulative processes, and to become acquainted with the boys while engaged in the performance of shop-duties.

7. Shop-instruction and supervision ou a practical and systematic basis has been attempted, and to a certain extent carried out. The experience thus gained will be invaluable in future.

8. A number of problems, drawings, etc., have been prepared by our teachers from data gathered in and about the shops, and the use of these enables the instructors to make the instruction much more interesting and profitable than it would have been had the instructors relied solely on the use of text-books.

9. The nucleus of a physical laboratory for class-instruction and experiments by students has been formed.

10. A classification of the various steps of apprenticeship has been attempted, and some headway has been made toward that end, with a view to correcting errors in existing methods of apprentice work and adopting the school-instruction to the wants of the shop. Efforts have also been made toward working out systematic plans of shop-instruction for educational results.

11. An important and extensive collection of scientific and mechanical books and magazines has been carefully made for the library.

12. Apprentices have, through the school, been brought into intimate relations with the library, and have thus been induced to do a considerable amount of useful reading.

13. Although we have not yet succeeded in putting the Cadet classes into operation, much prejudice has been overcome, and many who at first did not believe in such

a school have been led to see that school-instruction as supplementary to apprenticeship is both possible and desirable.

14. The knowledge of the maintenance of such a school by the Baltimore and Ohio Company has spread through the community and the country at large, and has given the Company credit for manifesting a tangible interest in the welfare of its employes, and for thus adopting efficient and practical measures toward the effectual solution of labor problems.

Already other railway companies have indicated their intention to adopt certain features of our school-work in their shops.

15. Finally, the managers and teachers of the school have gained much practical experience that will be of great service in the future management of the school. The way has been prepared for the organization of the Cadet classes, and young men are ready to enter upon advanced courses of study as soon as these classes can be organized.

Very truly, yours,

G. P. COLER,
Principal.

DEPARTMENT OF DRAWING.

G. P. COLER, *Principal:*

DEAR SIR: When the instruction of apprentices in drawing first began, but little could be accomplished, owing to two causes: 1st. The character of the students; 2d. Lack of facilities. With only a few exceptions the students then in the school were those who had been for some time in the service, who had entered simply for work, and not with any idea or desire for "schooling," and who had been conditionally admitted to the school on an entrance grade far below the regular passing-mark. Their *capacity* for instruction was so limited as to render any attempts at it very discouraging. No drawing instruments were obtained for some time, and consequently no mechanical drawing was done at first, and the instruction consisted entirely of free-hand drawing.

Since then the condition of affairs has changed very much for the better. Drawing instruments were purchased and other facilities provided. The work in free-hand drawing is now equipped with a set of Prang's Drawing Models, a partial set of compressed paper "modèls en relief," and a few other models made at the school. The work in projective drawing is illustrated by a set of models showing the intersections of various geometrical solids by planes or by other solids. The most of these last-mentioned models were made by myself, and the list is rapidly being increased. The work in machine drawing is aided by a set of Thorne's working drawings which illustrate the best methods of practice.

The grade of the entrance examinations is now more rigid, and the larger part of the old students have either left the school, completed their apprenticeship, or have been dropped from school-work for incapacity. Raising the grade of the school-work is having a very noticeable result in the corresponding improvement in the character of the apprentices now in the service. Of those who have entered the service since the organization of the school, the majority are young men who would never have entered as apprentices except for the school, and it has come to my personal knowledge that some of the best of them are only continuing in the service in the hopes of the speedy enlargement of the facilities of the school. There are some cases of students showing an aptitude for drawing amounting almost to genius, and who already do work which, on the score of *neatness*, will compare favorably with that of the majority of professional draughtsmen, and who only need

additional training in the technicalities of draughting to make them proficient draughtsmen, and valuable material from which the company may recruit for their drawing-rooms. One of the apprentices has already been advanced from the machine-shop to the draughting department, and only recently we had occasion to recommend another apprentice in answer to a call for another student for the same purpose.

On February 1, 1886, there were 78 students in the drawing classes of the school. Of these, 30 are still in the school. The remaining 48 have either left for cause, or have been dropped from school-work because they showed an incapacity or unwillingness to learn that made it impolitic to waste further energies on them. There are at present 58 students in the various drawing classes. The number is steadily increasing, the additions being invariably of a much higher grade than any of the apprentices were at the formation of the school.

The course in drawing now consists of a first-year class in geometrical drawing, a second-year class in projective drawing, a third-year class in machine drawing, a class in free-hand drawing, and a class in descriptive geometry. The instruction is almost entirely "individual" instruction rather than "class" instruction—this plan rendering it possible for each student to progress as fast as his ability warrants, and allowing his work to be slightly varied as his future requirements may demand. The drawings sent to you not long ago are a fair exponent of the system of drawing at present followed in the school. As soon as a proposed sectional model of a steam engine can be obtained, the instruction in machine drawing will be amended to include the making of working drawings direct from the models. The class in machine drawing is now engaged on the subject of spur gearing, and this will be followed by work in bevel and worm gearing. It is intended ultimately to give a systematic course in machine design.

Very respectfully,

WALTER L. WEBB,
Instructor in Drawing.

DECEMBER 31, 1886.

DEPARTMENT OF MECHANICS AND PHYSICS.

G. P. COLER, *Principal:*

DEAR SIR: Instruction in science was not begun until the school had been in operation for some time. A class in physics was first formed, and this year one in mechanics was organized. In addition to this regular work, occasional lectures have been given to other classes or to the whole school. My connection with the school began February last. There have been under my charge about seventy apprentices, in classes ranging from twelve to thirty members.

The aim has been to impart a knowledge of some of the elementary and fundamental principles and laws of the subjects considered, to illustrate them by experiment, to direct attention to their important applications, and especially to awaken an interest in this kind of study and cultivate habits of thoughtfulness and a desire for an intelligent understanding of the things which fall immediately to the notice of the student, such as the principles involved in the machinery he uses. It has been borne in mind also that these subjects are the necessary foundation for subsequent study of mechanism, the steam engine and other advanced and technical subjects, and especial attention has therefore been given to those topics which are of most importance as preparation for such subjects.

The method of instruction has been rather an experimental presentation of the subjects at hand, together with questions and class discussion, than ordinary textbook recitation. The boys have naturally shown a particular liking for experiments, and this has been encouraged by the introduction of such experiments as have been practicable. They are not made mere shows, but are presented in such a way as to

demand careful consideration of the methods employed and the results obtained. The class in mechanics, for example, arrives at principles and laws as the result of experiment; these are then applied to the solution of problems, many of which are to be determined both by the law and as the result of special experiment. Among the latter may be mentioned the determination of the pressures of variously loaded beams upon their supports, and of the tension on the tie-rod of a crane of given form when supporting a known weight. A considerable part of this work is performed by the boys themselves. This, besides giving clear understanding and increased interest, serves to make a direct connection between actual and theoretical work; it shows the way in which theoretical study may benefit the practical workman, and also leads to habits of considering and methods of dealing with real and practical problems at first hand.

Several causes have tended to make the results less satisfactory than they might otherwise have been. Many of the boys have had no previous study or training in this kind of work and are prepared only for what is most elementary; the classes have not been well graded, and that which is too advanced for some is already very familiar to others; the attendance has been made irregular and the time for study (which is meagre at best) has been seriously interfered with by night-work in the shops; there has been almost no apparatus except that constructed with limited facilities by the instructor. One of the most valuable results, however, is the change in the attitude of the boys as a class toward study and school-work. At first it seemed that the boys attended their classes simply because they were compelled to do so; they manifested little desire for anything better than not to go to school. It was then a difficult matter to even hold the attention of a class. During last year there was marked improvement in scholarship and interest, which was, I think, furthered by occasional visits to the shops and short talks with the boys concerning their school and shop-work. This year opened with fresh earnestness and spirit. The improvement made by those attending last year, and the superior class of apprentices who have recently entered the service (many of whom have done so especially to avail of combined shop and school advantages), render the instruction much more satisfactory, both as regards the grade of the work and the spirit with which it is done.

The marked change which the school has undergone during the past year is, in my estimation, a matter of congratulation and gratifying surprise. The influence of the school in raising the character and general intelligence of the apprentices, their ambition to improve, and their increased earnestness, cannot but lead to most satisfactory results in their value and efficiency as workmen.

Very respectfully,

CHAS. F. SCOTT,
Instructor in Mechanics and Physics.

DECEMBER 31, 1886.

CHAPTER VI.

TECHNICAL MECHANICAL SCHOOLS.

Account of five notable Technical Schools in the United States. Pages 171–223.

The Worcester Polytechnic Institute, formerly known as the Worcester County Free Institute of Industrial Science—The State Report for 1871—State authorization for free technical schools in cities and towns suggested in this report—This Institute founded by John Boynton, Esq., a citizen of Worcester, Massachusetts—Purpose of the school defined—Hon. Stephen Saulsbury, further endows the School—Bequest by the late Hon. Ichabod Washburn—The course of instruction—The catalogue of 1890, shows the development of the school since its establishment in 1868—The tendency of institutions to eliminate the term "Industrial" from their titles—Professor Thompson, first Principal of the Institute, is called to take charge of the Rose Polytechnic Institute, at Terre Haute, Indiana—List of the Faculty of the Worcester Polytechnic Institute in 1890. Page 173.

The Rose Polytechnic Institute—Brief account of the school and its founder, Chauncey Rose—The school first known as the Terre Haute School of Industrial Science—The name changed by the Trustees in honor of the man whose liberality and public spirit had created the Institution—Chauncey Rose a public benefactor of the same class as Stephen Girard, Peter Cooper, Charles Pratt, Anthony J. Drexel, and their noble compeers—The inauguration of President Thompson and the opening of the Institute—The early decease of the lamented President—The calling of Professor T. C. Mendenhall to the Presidency—Successful administration of President Mendenhall—He is called to take charge of the U. S. Coast and Geodetic Survey—Dr. Henry C. Eddy, Dean of the University of Cincinnati, succeeds President Mendenhall—Abstracts from the catalogue of 1893—List of Faculty. Page 184.

The University of Illinois, Urbana, Illinois, formerly known as the Illinois Industrial University—School of Mechanical Engineering—Brief history of the University—The child of the Nation and the State—Programme of courses in Drawing and in Mechanical Engineering—Impulse to Art study, and an Art collection, given by President Gregory—List of Faculty in 1874–'75—The Legislature applied to for change of name in 1885—Extracts from Petition of President Peabody to the Legislature in 1885—Growth of the University shown by catalogue of 1891–'92—Courses in Mechanical Engineering. Page 202.

The Mechanical courses in Cornell University; "Sibley College of Mechanic Arts"—This department founded and endowed by Hon. Hiram Sibley, of Rochester, N. Y., in 1870—Programme of the several courses—The Building—List of the Faculty in 1874–'75—The grand result of the foresight and public spirit of Ezra Cornell—The remarkable growth of Cornell University—Report by President Adams for the year 1891–'92—The growth and needs of Sibley College—Increase in value of the property and endowment of Cornell University to August 1st, 1892—Report by Professor Thurston, the Director of Sibley College—The Department of Industrial Training and Art—Report of the Sibley College in the Register of the University, December, 1892. Page 208.

The University of California, College of Mechanics, Berkeley, California—Historical summary of the University—College of Mechanics under Professor Le Compte, opened 1870—Chair of Industrial Mechanics founded 1874—Drawing a leading study—List of Faculty in 1875—Details of the courses in 1891-'92 will be found in the account of the University in the chapters given to the Land Grant Colleges—Analysis of students attending different departments of the University in the year 1891-'92. Page 220.

INTRODUCTORY.

The five schools here grouped together, though situated in localities so far removed from each other, find a common bond uniting them in sympathy and purpose, in the fact that they owe their origin to a recognition of the difficulties which everywhere hedge in the path of the American boy who wishes to make himself a skilled mechanic. Apart from the confessedly unsatisfactory training to be found in such poor remnants of the apprenticeship system as survive to our day, the several Trade Unions, composed often largely of European emigrants, rigidly limit the number of apprentices, or learners, to be allowed in any given shop. Were there no such limitations, however, the multiplication of machinery in all the processes tends to make of the ordinary workman a sort of automatic attachment to a machine; and if the boy enters a shop as an apprentice his chance of becoming an intelligent, efficient, all-round mechanic, a well-equipped artisan, qualified to adapt himself to changing exigencies, is very small.

The superiority of systematic instruction over any "rule-of-thumb" practice, has come to be so generally admitted; that the public-spirited, philanthropic men, who set themselves to find a solution of the problem of training a race of skilled artisans, provided, as a matter of course, for the establishment of a training school of some kind. The school at Worcester, was the first institution definitely planned to effect this purpose; and the four other schools here described were founded on similar lines and have therefore been grouped together.

The blending of actual shop-work with intellectual training was the distinctive feature adopted in Worcester by Professor Thompson, and was likewise inaugurated in the school at Terre Haute. The tendency in all such combinations of intellectual and industrial training is towards the preponderance of the one or the other; as, in a greater or less degree, has happened in the Land-Grant Colleges between the branches of Agriculture and Mechanics.

The students find themselves led to higher branches of education than they had at first contemplated and the very excellence of the training tends to raise the character of the school above its first intent. So it may prove with these schools; engineers and scientists may be the product instead of the merely skilled mechanic who was first expected. A brief history of the schools and of their founders,

with a showing of their equipment, methods, and courses of study, is all that is here attempted.

The Worcester Polytechnic Institute; formerly known as The Worcester County Free Institute of Industrial Science, Worcester, Mass.

The Massachusetts State Report for 1871, pronounces this as "the only school in the State where a technical Education in Mechanics combined with practice can be obtained" and characterizes it as "a model institution which has no superior in the Country."

The Board, while not deeming it "feasible or advisable to attempt to give technical instruction in the common schools, other than drawing, suggest that the State authorize cities and towns, having a population of 5000 inhabitants and over, to establish free technical schools for instruction in such branches of knowledge, common to the leading industries of the entire State, as may, from time to time, be prescribed by the Board of Education."

This recommendation shows clearly that the State Educational Authorities of Massachusetts at that time, fully appreciated the fact that the teaching of the public schools needed to be supplemented by special Industrial training.

This Institution, like the Cooper Union of New York City, owes its existence to the wise beneficence of a private citizen whose gifts have been added to by other public spirited citizens.

The school was founded by John Boynton, Esq., Templeton, of Massachusetts, in 1865, and its scope and purpose are set forth in the following extract from his letter of gift, dated May 1, 1865:

Being desirous to devote a portion of the property, which, in the good providence of God has fallen to my lot, for the promotion of the welfare and happiness of my fellow-men, I have determined to set apart, and do here set apart and give the sum of One hundred Thousand Dollars, for the endowment and perpetual support of a free school or institute, to be established in the County of Worcester, for the benefit of the youth of that county.

The aim of this school shall ever be the instruction of youth in those branches of education not usually taught in the public schools, which are essential and best adapted to train the young for practical life; and especially, that such as are intending to be mechanics, or manufacturers, or farmers, may attain an understanding of the principles of science applicable to their pursuits, which will qualify them in the best manner for an intelligent and successful prosecution of their business; and tbat such as intend to devote themselves to any of the branches of mercantile business, shall in like manner be instructed in those parts of learning most serviceable to them; and that such as design to become teachers of common schools, or schools of the like character as our common schools, may be in the best manner fitted for their calling; and the various schemes of study and courses of instruction shall always be in accordance with this fundamental design, so as thereby to meet a want which our public schools have hitherto but inadequately supplied.

In forwarding Mr. Boynton's purpose by a gift of Two Hundred Thousand Dollars, with special reference to enabling the Institute to receive students who are not residents of the County, Hon. Stephen Salisbury says:—

There is no intention and no desire to establish here a rival, or a substitute, for the college. This school will not attempt to turn out in this short period an Arkwright, a Stephenson, or a Fulton, but it may give facilities and helps which these great mechanics did not possess. In a very wise speech recently made by Earl Carnaroon, before the National Association for the promotion of Social Science at Birmingham, he says, 'I will only say of all technical education, whether of the higher grades of professional life or of those lower paths with which the manual labor of the individual artizan is concerned, that its basis must be laid in sound principles of elementary instruction, and that the later teaching is dependent on the earlier.

In addition to these two princely gifts, the late Hon. Ichabod Washburn, of Worcester, provided that,

There shall be a machine shop of sufficient capacity to employ twenty or more apprentices, with a sufficient number of practical teachers and workmen in the shop to instruct such apprentices, etc.

The shop is a handsome three story brick building, one hundred feet long, by forty feet wide, with a wing sixty five by forty feet, for engine, boilers and blacksmith-shops. These rooms are all equipped according to directions of the benevolent donor, and furnished with every facility for practical work.

The main building known as Boyntou Hall, is a commodious and elegant granite building, 146 feet long by 61 wide, built by the citizens of Worcester. It contains a chapel seating four hundred persons, lecture and recitation rooms, rooms for drawing, also rooms for chemical and physical laboratories which are fully equipped. The value of the two buildings of the Institute is estimated at \$120,000. The endowment fund is \$600,000. The income for the past year 25,000. The Institute is under the supervision of a Board of Trustees of whom Hon. Stephen Salisbury, is President. Professor Charles O. Thompson, A. M. is principal of the Institute assisted by a Corps of seven Professors. There is also a Superintendent of the Machine Shop, an Instructor on Field work and Topography, a lecturer on Geology and an assistant in Chemistry. There were 99 students the past year, divided among three classes, Junior, Middle, and Senior. There is also an Apprentice class, so called, who devote much more time than the others to practice in the Machine Shop. They spend 48 hours a week in the shop, eight in free-hand drawing, and five in recitation." The Apprentice Class of 1874, numbered 19. The school year is divided into two terms. There is no charge for tuition to residents of Worcester County. Others are charged \$100.00 per year, payable semi-annually in advance. In 1869, the State made a grant of 50,000 to the Institute, on

condition of its receiving annually, twenty free pupils from locations outside of Worcester County. Hon. Geo. F. Hoar also made a gift to the Institute by the terms of which three students, from that part of Norfolk County, which was formerly included in the ninth Congressional district, may receive free tuition.

The course of instruction covers three years and is so planned that the student can acquire thorough elementary knowledge of at least one of the following branches—

1. Mechanical Engineering.
2. Civil Engineering.
3. Drawing.
4. Chemistry.
5. Physics.
6. English, French and German.

At the Middle of Junior year, each student, except the Mechanics, chooses a department, under the advice of the instructors, and from that time to the end of the course devotes to it his practice time of ten hours each week, and the whole of the month of July.

DRAWING.

All the students spend eight hours a week Junior year, and two hours a week Middle year, in free-hand drawing; and six hours a week Middle and Senior years, in mechanical drawing. The course in free-hand drawing is nearly identical with that pursued in the South Kensington Schools of Art. By carefully studied exercises in outline drawing, shading and coloring, from copies, models and casts, and by blackboard-work, discipline of the sense of form and proportion is secured and an ability to delineate objects is acquired which is of great value in all departments of applied science. In the mechanical drawing-room, instruction is given in the use of instruments, shading and coloring, plane and isometric projections, and the theory of shades, shadows and perspective. The course in drawing is the best preparation for the business of a designer, whether for prints, fresco and ornamental painting, or any other similar art. All drawing is done under the eye of the instructor.

Every student in the department of Mechanics, in addition to the work just specified, is required to make at least one complete set of working-drawings in the shop, under the direction of the Superintendent, for use in the shop. There is abundant material for use in the instruction of the students in the way of casts, models, and patterns. The nature of the Institute, and the purpose had in view by the teachers in their plan of instruction, is set forth by Professor Thompson, in the following paragraphs from his annual statement for 1874–5 from which most of the preceding facts have been taken.

This Technical School is located in the City of Worcester, Massachusetts, the centre of a thriving and extensive manufacturing business. The opportunities thus offered to observe the various forms of practical industry are signally advantageous to the students of the Institute. It is now fully organized and has graduated four classes. The ease with which most of these young men have at once secured hon-

orable lucrative employment confirms the Trustees in their confidence in the soundness of the general principles upon which the School is organized and carried on.

In its scope and purpose it is essentially like the technical schools of Europe, but gives special prominence to the practical element.

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What is wanted is a system of training boys for the duties of an active life which is broader and brighter than the popular method of "learning a trade," and more simple and direct than the so-called "liberal education." That is, boys must have a good education based on the mathematics and the physical sciences, and know enough of some art or trade to enable them to earn a living when they leave school. It is clear that schools in which this result is reached must be essentially new, and that the plan of instruction must involve some manual labor. The advocates of this system do not pretend that it is adequate to all the intellectual wants of the century or of the country, but they claim that it meets *a* want long and widely felt.

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Attention is exclusively confined during the first year's drawing time to free-hand work. Such discipline of the sense of form and proportion is secured in this way, and so much dexterity in developing various forms is acquired by the students, that when they begin shop work they make more rapid and satisfactory progress than those who have not had the advantage of this training.

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The boys are advanced as fast as possible. They are thus relieved of one hindrance to apprentices, *in general*, who are required to do all the rough work of the shops, on the ground that in this way the owners can get some compensation for the subsequent labor of teaching them. The students, therefore, have three advantages, viz: the discipline and culture of free-hand drawing, careful distribution of their time, and relief from all unnecessary detail. To these should be added the consideration which far outweighs them all, that they come to their work with the perceptive faculties, the reason, the judgment and the taste—all under constant and careful training in school. Theory and practice accompany and supplement each other, and both may pre-suppose the actual possession of the elements of all knowledge. With these advantages it is hoped that the graduates will be as skillful mechanics as ordinary apprentices who have served three years in a shop, with the immense additional advantages of educated faculties.

Now it is clear that the number of apprentices likely to be in the shop under these circumstances is so great, that its business prospects must be seriously dimmed. To offset this disadvantage, Hon. Ichabod Washburn, who gave the shop to the Institute, provided the building and its equipments (which by the act of Incorporation are free from tax), a fund of $5,000 to be expended for stock, and the interest of a fund of $50,000 to provide for contingencies. With all these advantages the work done by the apprentices is hardly an adequate compensation for the expense involved in their instruction.

A very serious objection to "trade school," and "manual labor departments," both at home and abroad, has been that boys had not an opportunity to see or to attempt the best kinds of work. Miscellaneous jobbing and inferior work are not the models for a boy to study, nor are second rate workmen his proper instructors. Nothing is too good for a boy, though the popular notion is the exact reverse of this. The determination on the part of the Superintendent to maintain the highest standard of workmanship has so far been successfully carried out, and is undoubtedly the only way to fulfill the design of the shop.

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The whole scheme must be regarded as an experiment in American education, which, at the present stage, is sufficiently promising to warrant its farther prosecution.

Prizes have been awarded by several Mechanics fairs in different cities to work from this shop.

Admirable sets of models for drawing classes are made by the pupils, these are from designs by the State Art Director, Mr. Smith, and are adapted to the wants of the public schools. A very ingeniously designed drawing table or stand is also made by the students.

It is to its full course in Drawing, and its special training for pupils as "designers," that this Institute has claims to our notice in the consideration of Institutions affording training in Industrial Art.—In its Mechanical, and Civil, Engineering Course, it offers similar instruction to that of the various scientific Schools of the country, and has no greater claim to special notice than they possess. Mechanical drawing is of course taught in all these schools. In the fact, however, that this is an effort made in one industrial community to supplement the common instruction, and attempt to meet a recognized want in the education otherwise offered by the State; it assumes special interest in connection with the question we are now considering. The claim that Drawing shall be made a required branch of all free public education, rests largely upon the necessity that has arisen for trained workers in all the industrial arts, and the fact that the present system of common School training is of very little, if any, practical advantage in fitting the pupils to become skillful workers. This Institute is the expression of the fact that, for those youth who have passed beyond the common schools, there exists no adequate opportunities for acquiring such training. It is at once, both an argument for the need of such preliminary training as can be given to the pupil in the public school, and an illustration of the means by which the existing want in our American industrial Education may be met.

That which the Cooper Union, The Franklin Institute, and the Maryland Institute, are seeking to do, as best they may, in their several localities, the Worcester Free Institute undertakes to do somewhat more systematically; as, having control of its students through a course of three years, it is enabled to do.

The latest catalogue at hand, that for the year 1890,* affords opportunity for noting the development of the school, and furnishes a record by which the results of the experiment here initiated in 1868, may, in part, be tested. The first noticeable fact is the change of name, which was authorized by the Legislature in May, 1877, to take effect July 1, 1877. From that date the school was no longer to be known as "The Worcester County Free Institute of Industrial Science," the appellation borne through its first decade, but, as "The Worcester Polytechnic Institute."

*Twentieth annual catalogue of Worcester Polytechnic Institute, 1890. Worcester, Mass. Press of Sanford & Davis. Pp. 99.

There must be some common reason for this desire, shown by these modern Industrial Institutions, to drop the characterizing term "Industrial" from their legal title. It will be observed, in the subsequent accounts of the Land Grant Colleges, that several of the latter have secured a similar change of name from their respective Legislatures.

The term "Polytechnic" would seem to imply a far more ambitious institution than the apprentice training school which John Boynton had in mind in his deed of gift. No objection can properly be urged against the upward progress of an Institution, any more than against the superior development of an individual, provided only, that, in this growth from a practical apprentice school, into an apparent rival of the Massachusetts Institute of Technology, and the higher schools of science of which that is a type, the doors of this school do not, of necessity, become closed and barred against the very class for whose benefit they were first opened.

The Schools of Science, and the Engineering Departments of Universities and Colleges, form a familiar, well defined class of educational institutions; but this Worcester School, stood almost by itself, and seemed to offer the typical model of a class of most desirable intermediate institutions between the free evening schools of the City Mechanics Institutes, and the technical professional departments of the higher Schools of Science, which would be of great practical value. In the "Washburn Shops," connected with the school, one of its most striking practical features is still preserved.

In 1889, a new department, that of "Electrical Engineering," was established. In this course an additional year of study, after having taken the full three years and a half of the Mechanical Engineering course, is required. A "Department of Physical and Political Science" is also announced to open in the autumn of 1891.—The wonderful development in the industrial applications of electricity, rivalling that which took place a half century and more ago in the like applications of steam, is the most notable scientific fact of the day, and one which has compelled the Higher Institutions of Science to a full recognition of its significance, and forced them to enlarge their courses of study. It, however, already enters into so many forms of machinery, and has created a demand for such a variety of original machines, that its recognition by this school was imperative.

To fairly contrast the present school with that of ten years or more ago, the following statements of the 1890 catalogue are quoted.—

GENERAL PLAN.

The Institute offers a good education,—based on the mathematics, modern languages, physical sciences, and drawing,—and a thorough knowledge of some branch of applied science. It is especially designed to meet the wants of those who wish to be prepared as mechanics, civil engineers, chemists, or designers, for the duties of their respective professions.

The plan of organization is in the main that of the Polytechnic schools of Europe, but with such modifications as are rendered necessary by differing conditions. Special prominence, however, is given to the element of practice which is required in every department.

In favor of this feature of the training adopted at the Institute, there may be assigned the following reasons:

1. The fact that some of the most successful and sagacious manufacturers and business men, as well as many able educators, continually recur to the idea of combining manual labor with school instruction, shows the increasing demand for a closer union of theory and practice in technical training.

2. Those who are actively engaged in the practice of Engineering, are generally agreed that every young man training for an engineer should acquire familiarity with the practical side of his profession. The acquirement of the manual dexterity, conceded by all to be desirable, may precede, accompany, or follow the theoretical instruction. In this school the two are combined.

3. Most of the young men who have graduated from the Institute have readily found employment in situations for which their technical education especially prepared them, and have proved themselves well fitted for their work.

But while practice is made thus prominent, it is insisted that it should spring from a clear comprehension of principles. Practice is not an end, but a means and help to the best instruction. With this view of its relation to theoretical work in the school training, the student's entrance on the pursuit he has chosen becomes an expansion of his course of study, rather than an abrupt transition to a new sphere of life.

In acquiring knowledge of any form of handicraft, or of the practical industries by which society is supported and carried on, it is essential that the student should work under conditions as like as possible to those which he will meet in life. The more his work is subjected to the inexorable tests of trade, and the more he feels just the same responsibility that is inevitable in actual business, the better.

Practice in the Institute is subject to two conditions:—First, it shall be a necessary part of each week's work; secondly, it shall be judiciously distributed, and constantly supervised.

At the middle of the Junior year every student who has not already done so* chooses, with the permission of the Faculty, a department and must pursue the studies of that department till the end of his course. The mechanical engineers practice in the shops from the beginning of the Apprentice half year, and their practice extends over the whole course of three and a half years.

Sixteen years of age is the lowest limit allowed for admission to the Junior class; the average age of those who enter is eighteen. The entrance examination required is about that admitting to a good High School, but it is recommended that candidates should have, if possible, such a preparation as would be required for entrance into college. All beginners in Mechanics must enter the "Apprentice class," and pass from that into the regular Junior class. The aim of the school is to give as complete a general education as possible. Pupils are taught also, to read French and German with facility.

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*See page 20, Apprentice Class.

ORGANIZATION.

Courses of study and practice are offered in the following departments:

1. Mechanical Engineering.
2. Civil Engineering.
3. Chemistry.
4. Electrical Engineering.
5. For course in Physical and Political Science see p. 42.

The training of students preparing to be mechanical engineers occupies three and one-half years; of those proposing to take electrical engineering four and one-half years; that of all others three years of thirty-eight weeks each.

PLAN OF INSTRUCTION.

Instruction is given by recitations, lectures and practice, which together constitute a symmetrical course of study. The course closes with the preparation by each student, of a thesis or report. Members of the Apprentice Class who appear in the Junior Class are excused from Free Drawing for the first half-year; and during Senior year the courses for the different departments vary, but otherwise all students attend the recitations and lectures appointed for their respective classes. But the exercises in practice are widely different.

Recitations.—The classes recite in small divisions, and time enough is allotted to each recitation to secure the utmost thoroughness.

Lectures are given by all the Professors on topics suggested by their work, as occasion may demand, and in some departments this form of instruction is, of necessity, chiefly employed. Students are in all cases required to take notes and to sustain examination on the lectures.

Theses.—Each student before graduating is required to prepare and submit to the Faculty a satisfactory report or thesis on some subject connected with his special department. At Commencement, abstracts of these papers are presented by the members of the graduating class.

The following is the work required in Drawing.

DRAWING.

All students are taught Free-Hand Drawing. The course for the Apprentice Year embraces (1) black-board practice, (2) the principles of Orthographic and Isometric projection as applied to construction in the Shop, (3) the principles and practice of lettering, (4) outline sketching from geometrical solids and natural objects. During Junior Year the student is given (1) advanced outline drawing from objects, working models and from machinery, (2) principles of light and shade as applied to object drawing, (3) sketching and shading from nature. In the Middle Year the time is alloted to (1) diagram drawing and enlarging in color, (2) principles of color as applied to Free-Hand Object Drawings, (3) sketching and coloring from nature.

In the Mechanical Drawing Room instruction is given in the use of instruments, shading and coloring, plane and isometric projections, and the theory of shades, shadows and perspective; also, in making detailed and finished working drawings of machines from specific data, including the drawings used in the construction of the machine or motor built in the Washburn Shops by the Senior Class. * * * All drawing is done under the eye of the instructor.

In Mechanical Engineering and Shop practice the general course of the method of instruction and work is as follows:

DEPARTMENT OF MECHANICAL ENGINEERING.

Those who desire to begin the course in Mechanical Engineering must enter the *Apprentice Class.* A limited number, however, may be admitted to this department at the September examination, *provided* they have had at least one year of actual work in wood or iron in some approved shop. In each case a certificate from the proprietor or foreman of the shop will be required, setting forth the amount and kind of work which the apprentice has done. The work in this department, except the shop-practice, will be carried on, after September, 1889, in the Salisbury Laboratories.

The course in Mechanical Engineering, in addition to the studies common to all departments includes instruction in Theoretical and Applied Mechanics, Thermodynamics, Steam Engineering, Engineering, Laboratory work and Shop-Practice.

* * * * * * *

SHOP-PRACTICE.

Two principles are observed in the arrangement of the practice in this department; First, that while labor with hand tools and machines should be wisely blended, yet, since machinery has a constantly increasing share in the conversion of material into useful forms, the educated mechanic should know how to design, construct and assemble the parts of a machine, as well as how to make its product; and, second, that excellence in construction is to be sought as a most valuable factor in instruction.

The power of the engineer to decide upon general grounds the best form and material for a machine, and to calculate its parts, is greatly increased by blending with it the skill of the craftsman in minipulating the material, and the fact that the product is to be tested and used, kindles interest in its manufacture and furnishes additional incentive to thoroughness and exactness. After the earliest lessons, the practice is on commercial goods, and follows the best methods of commercial production.

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Here the students in Mechanical Engineering spend their practice hours as apprentices, and it is found that the graduates in this department are as skilful mechanics as ordinary apprentices who have served three years in a shop, and they have in addition the advantage of a solid education. This result is attained under the following conditions:

1. These Shops are organized and managed as a manufacturing establishment, and a great variety of work is always in process of construction, in order that the students may constantly have the wholesome atmosphere of real business. This, with a determination on the part of the superintendent to maintain a high standard of workmanship, has made the progress of the students in the best methods of construction both rapid and thorough, and has proved the most effective means of giving them an exact knowledge of shop practice.

2. The work of each student is done under the personal supervision and direction of a skilled workman, and with the advantage of the best obtainable tools and machinery; for it is as true in handicraft as in the training of the intellect, that the best tools and appliances are not too good for instruction.

3. Every student receives training in drawing during the entire course. In this way exact knowledge of form and proportion is secured, and the students make more intelligent and satisfactory progress in the shop, than it is possible for those who have not had the advantage of this training. Besides the general training in free-hand and instrumental drawing, students in this department have practice during Senior Year in making working-drawings of machines, and determining

the strength, dimensions, and proper proportions of machines from numerical specifications.

4. The weekly practice is distributed so as to occupy five hours each of two days. Each student is required to render a strict account of these hours. The time thus spent serves the double purpose of practice and of exercise.

5. Each student advances as fast as possible, unchecked by the difficulties of his neighbor, or any business necessity of the shop.

To these advantages, viz. the service of construction in the work of instruction, and discipline and culture of free-hand drawing, careful distribution of time, and relief from all unnecessary detail, should be added the consideration which far outweighs them all, that the students come to their work with the perceptive faculties, the reason, the judgment and the taste all under constant and careful training in school. Theory and practice accompany and supplement each other. Under these conditions, it is clear that the students must during their practice have direction and efficient instruction. To provide for this, Hon. Ichabod Washburn also gave a fund of $50,000, the income of which may be applied towards paying the running expenses of the shop, with the expectation that twenty young men would receive its benefits. With the present facilities, over one hundred are accommodated.

In general the members of the Apprentice Class are taught the use of wood-working tools and machinery, and are given a thorough course in pattern-making. Also, there is instruction and practice in moulding, and casting soft metals. Plans for an iron foundry commensurate with the other shops are projected. The Junior, Middle and Senior Classes work mainly on iron.

Practice in the Shops and Draughting rooms is given in manufacturing the products enumerated on the last pages of the catalogue. It comprises,

IN THE WOOD ROOM:

Bench Work.—This includes a great variety of manipulation, under constant instruction, in laying out work with knife and pencil, the use of planes, the handsaws, chisels, gouges, squares, gauges, and other tools.

Wood Turning.—With the use of the various turning tools, on hard and soft wood.

Machine Sawing.—With large and small circular saws, and scroll saws.

Machine Planing.—With the Cylinder and Daniels planer. Machine boring, the use of the shaping and moulding machines, and the auxiliary manipulations of all the machinery used.

IN THE IRON ROOM:

Bench Work.—Filing and chipping, preparing work for lathes, tapping, reaming, scraping and fitting plane surfaces, finishing with oil-stone and emery cloth.

Work with Speed Lathe.—Drilling and countersinking, filing and polishing, hand-tooling.

Work with Engine Lathe.—Instruction in the use and care of lathe and turning tools, squaring up, the proper and maximum speed for cutting metals, turning to exact size, the use of the caliper, a variety of turning, both heavy and light; cutting threads, squaring up and finishing nuts, chucking straight holes, reaming, inside boring, boring with boring-bar, fitting bearing, etc.

Drilling.—With speed-lathe, upright and traverse drillers.

Milling.—Use of the universal milling-machine—milling-nuts, bolt heads and studs, cutting splines, fluting taps and reamers, milling to size and line, cutting gears.

Planing.—Instructions in the use of the planer, planing surfaces and bevels.

Work with Screw Machine.—Making machine bolts with revolving head screw machine, cutting up stock, making screws and studs, and tapping nuts.

Tool Making.—The correct forms of turning tools, and the principles of grinding them; making taps, dies, reamers, twist-drills, countersinks, counter bores, mills, milling-machine cutters, mandrels, boring-bars, chuck-drills, centers.

Management of Steam.—Care of the boilers and engine, including the work of firing; the care and control of the steam pressure and the water supply; also the care and manipulation of the steam pump and injectors. The practice in the steam department is under the constant oversight of the Engineer.

Designing and Constructing.—In Senior Year after the students have each accomplished the practice just specified, they will build one or more complete machines from their own drawings. These drawings, though made from definite specifications, are intended to afford ample field and scope for the personal responsibility and originality of each student in making correct design and arrangement of parts of the machine in hand. While this work is not copying, it must not depart essentially from the best practice among manufacturing mechanics. Previous classes have constructed a twenty-five H. P. Corliss Engine, a ten H. P. Upright Reversible Engine, a forty H. P. Buckeye Engine, a thirty H. P. high speed Straight-Line Engine; the Class of 1885, an Engine Lathe, eighteen feet in length and having twenty-six inches swing, the Class of 1886, a Hendey Shaper, the Classes of 1887 and 1888, a complete No. 1 Cabinet Turret Lathe, the Class of 1889, a sixteen-inch Swing Lathe, with eight-foot bed, and the Class of 1890, two improved Engine Lathes.

While we depend mainly upon real work, with machines and tools in the hands of the students, to give him practical knowledge and experience, we also desire to make the instruction as broad and general as possible.

For this purpose a beginning has been made of a permanent exhibit of the best American and foreign tools of all kinds, properly arranged and open to the inspection of the students, and used as an illustration of the best, so that the students may become familiar with standard tools and the names of the makers. This exhibit of tools and machines is used in lectures and general instruction to classes.

A certain number of students from the State, from the County of Worcester, and from certain towns formerly in the 9th Congressional District, (these provided for by Hon. George F. Hoar, U. S. Senator, formerly Member of Congress from the 9th District,) are admitted free from tuition charges. Others pay $150.00 a year tuition. The entire expenses of a student are estimated at $450.00 a year. Very interesting statistics are given, showing by classes, the present residence and occupation of all the graduates. Nineteen classes have been graduated showing a total membership of 893, of whom 455 completed a three years course, and 434 graduated.

"More than 90 per cent. of the graduates are engaged in occupations for which their training at the Institute specially prepared them."

Several pages follow in the catalogue showing some of the articles made at the Washburn Machine Shops. Among these, are the sets of the admirable "American Drawing Models," designed for school use by Walter Smith; and an excellent adjustable Drawing Stand—these articles are patented.

THE LATE PROFESSOR THOMPSON.

Fortunate as the Worcester County Free Institute was in the liberality of its founder, John Boynton, and in the generous gift by Mr. Saulsbury, the bequest by the late Ichabod Washburn, and the hearty co-operation of Senator Hoar, it may be questioned whether, after all, the good providence which gave to the capable hands of Professor C. O. Thompson, the shaping of its earliest organization, and the directing of its course for a period of fifteen years, was not the best fortune of all. Professor Thompson, with enthusiasm and intelligence, undertook to solve the problem presented by this educational experiment. Familiar with educational methods, and with European experience in technological institutions, he set himself to the creating of a kind of school before unknown in this country. So satisfactory was his solution of this problem that when another liberal American, like minded with John Boynton, proposed to do likewise for his western country, and, after careful investigation, had fixed upon a satisfactory plan, he set for his model the Worcester School. Dying before the Institution he had initiated was ready for opening, the Trustees, who sought to carry out his intentions, secured as the man to direct his proposed Institution, the one who had made the Worcester School a success; and induced Professor Thompson to resign his position at Worcester, and to accept the Presidency of the Institute. After a preliminary visit to Europe and study of European Schools of Technology, President Thompson was inaugurated March 7th, 1883. The new Institution, largely on the line of the Worcester School, was begun under brilliant auspices. This new career so brightly opening before him was, however, suddenly cut short by the death of this most promising Educator, in the very plenitude of his powers.

The story of his short administration* of the Rose Polytechnic Institute will be told in connection with the account of that School, which here follows.

The catalogue of the Worcester Polytechnic Institute for 1890, shows 171 students in attendance. The "Faculty" consists of eleven Professors, there are also twelve "other Instructors."

Homer T. Fuller, Ph. D. is President and Professor of Geology and Mineralogy.—George I. Alden, S. B. is Professor of Mechanical Engineering. George E. Gladwin, Professor of Drawing. Milton P. Higgins, S. B. Superintendent of Washburn Shops.

Rose Polytechnic Institute, Terre Haute, Indiana.

This Technical School, modelled after the plan of the Worcester County Free Institute, with its equipment and methods chosen and

* The admirable Inaugural address by President Thompson will be found in Appendix X.

perfected by the distinguished Educator who had created the Worcester School, and who had brought to the shaping and directing of this new institution not only the result of his years of teaching experience in Worcester, but the fruits of a personal examination and careful study of the leading Scientific and Technical schools of the United States, and of Europe, undertaken with the direct purpose of perfecting the plans of this proposed institution, should certainly rank as a model of its class.

It stands to day in perpetual memorial of the two men to whom its existence is due.

Chauncey Rose, the Founder, belonged to a class of American men not uncommon during the first half of the Nineteenth Century; the enterprising energetic emigrants who went out from the older States to settle upon the unoccupied lands of the West, the hardy pioneers of a new settlement, wide awake and ready to seize upon and develop the opportunities then offered with free hand by Fortune. To these qualities, inherited and developed by New England Ancestry and training, and shared by a class of sturdy citizens, the Founder of this Institute added an appreciation of his relations to the Community, and an interest in his fellow men, which led him to regard the large fortune with which his sagacity and enterprise had been rewarded, as only held by him in trust for his fellows.

It is this characteristic which marks him out as an unusual man, and enrolls him in the small class of liberal educational philanthropists whose deeds illumine the pages of American progress; with Girard, Cooper, Cornell, Pratt, Drexel, and their compeers.

Chauncey Rose, was born in Wethersfield, Connecticut, December 24th, 1794, and died at Terre Haute, Indiana, August 13th, 1877. He was unmarried. His paternal grandfather was an emigrant from the Highlands of Scotland early in the last century. His mother was Mary Warner, of Wethersfield; and he seems in himself to have combined the indomitable self-reliance, enterprise, integrity and thrift, of both his Scotch and New England ancestry. Surviving his six brothers and single sister, all of whom died childless, he was literally "the last of his race." His only schooling was that then given in the district common schools of Connecticut.

In early manhood, like so many other New Englanders of that day, he left his native State, and started upon an exploring tour through the then "West;" visiting Kentucky, and Indiana, in 1817, and, finally, in 1818, took up his residence in the town of Terre Haute, Indiana; which had been laid out only two years before. After farming a few years he became a merchant, and was widely and favorably known throughout that neighborhood.

When the era of Steam Transportation began Mr. Rose was among the first to realize its importance, and he is credited with the early promotion and successful completion of the Railroad from Terre

Haute to Indianapolis; and became, from that time, largely interested in railroad enterprises. The rise in value of land,—as the outlying farms in turn were changed to city squares,—in which he had early invested his savings, and the immense and rapid development of the steam roads, by which in like manner in New York, the great Vanderbilt fortune was built up,—combined to increase his wealth. Two of his brothers were, also, likewise successful in amassing fortunes. On the death of one of these, John Rose, in New York, it was found that, owing to some technicality, the intentions of his will were in danger of being thwarted; Chauncey Rose, in order to prevent this, entered upon a litigation which lasted for six years, but resulted in setting the will aside, and Mr. Rose was recognized as sole heir. He then proceeded to dispose of this great fortune in accordance with his brother's intentions. He distributed one and a half million of dollars, between the 82 charitable institutions of New York City, and Brooklyn; giving, the largest single gift, $220,000 to the "Children's Aid Society" of New York; and $20,000 to the Brooklyn Society of the same name. The other gifts ranged in amount from seventy-five thousand, to one thousand, dollars. His native town was also remembered with a gift of $18,000 to the Wethersfield Seminary and $2,500 to the town Library.

In the disposal of his personal fortune by will, Mr. Rose, in addition to specific gifts to the Institute, as well as making it the residuary legatee of the estate; gave $150,000 to the Vigo County Orphan Home, and $75,000 to establish a Free Medical Dispensary. His liberal gifts during his life to worthy charities, and to public enterprises which commended themselves to his judgment, were well known; while his private benefactions, mostly unknown during his life, were continual.

He always took great interest in promoting education, and by gifts to Wabash College, and to the Library of the State Normal College, and by aiding pecuniarily many young ladies there to fit themselves to become teachers, he had shown this interest; but he desired especially to promote the practical education of young men in a way to fit them for the best service; and at last fixed upon the plan of founding a polytechnic school.

In the steps that Mr. Rose took to carry out his plan, he displayed all his best traits. Naturally distrustful of his own knowledge of schools, he went to see some of the most noted institutions that gave prominence to scientific subjects, and consulted all his friends who had any knowledge or experience in such matters. The timely and judicious suggestions of these friends—and we name, without disparaging the weight of others, Josephus Collett and Barnabas Hobbs—had decided influence with Mr. Rose in his final decision to endow a polytechnic school.

To obtain the information necessary to determine in what mould the institution should be cast, he commissioned* two of his associates in the corporation to make

* Charles R. Peddle, Esq., Superintendent of Motive Power on the Vandalia Railroad, and President William A. Jones of the Indiana Normal School.

a thorough inspection of all institutions in the country that offer courses in higher technology. This committee discharged their duty most faithfully and presented to Mr. Rose an elaborate report, in which the features and statistics of each of the great polytechnic schools in the United States are carefully set out.

Mr. Rose studied this report long and thoroughly. He sought counsel and information from every available source. The result was that he decided to repeat, as far as changed circumstances would permit, the plan of the Worcester Free Institute. *

The following authoritative statement continues the history of the Institute down to its formal opening with the inauguration of President Thompson.

This is given in the handsomely printed pamphlet which contains a full report of the Inaugural Ceremonies and Addresses with a portrait of the Founder, and views and plans of the commodious buildings.† As a brief account of the opening ceremonies and addresses, together with a full report of the admirable Inaugural Address by President Thompson, will be found in Appendix R, no further notice of this event is here given.

HISTORICAL.

[Prepared at the request of the Board of Managers by Samuel S. Early, Secretary of the Board.]

The scientific school known as the Rose Polytechnic Institute, was founded in 1874, by the munificence of the late Chauncey Rose, of Terre Haute. As the honored life of this most generous and public spirited gentleman drew near its close, among the many benefactions that suggested themselves as deserving objects of his liberality was a school in which young men might be thoroughly trained in the sciences applicable to the industrial arts. Careful study of the plans and methods of such schools and consultation with numerous experienced educators fixed this suggestion in his thoughts, and out of his deliberations grew the establishment whose first detailed and formal publication of its progress and purposes is set forth in the following pages.

Inviting the assistance of his trusted friends, Messrs. Josephus Collett, Firmin Nippert, Charles R. Peddle, Barnabas C. Hobbs, William A. Jones, Demas Deming, Ray G. Jenckes, Gen. Charles Cruft and Col. Wm. K. Edwards, he associated them with himself in a body corporate in conformity with an act of the General Assembly of the State of Indiana, approved February 20th, 1867, and the amendments thereto, said act being entitled "An Act Concerning the Organization and Perpetuity of Voluntary Associations, and repealing an act entitled 'An Act Concerning the Organization of Voluntary Associations, and repealing former laws in reference thereto,' approved February 12, 1855, and repealing each act repealed by said act, and authorizing gifts and devises by will to be made to any corporation or purpose contemplated by this act."

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* From the pamphlet account of Rose Polytechnic Institute, republished from "Barnard's American Journal of Education." The authority for the biographical statements just made, is found in the "Memoir of Chauncey Rose," with which this pamphlet opens.

† Rose Polytechnic Institute, Addresses of Inauguration and Dedication, with Memorial notices, a historical introduction, and First Annual Catalogue. Terre Haute, Ind: C. W. Brown, printer and binder. 1883. Pp. 84.

On the 10th of September, 1874, articles of association were adopted, setting forth the objects of the corporation to be the establishment and maintenance, in the County of Vigo and State of Indiana, of an "institution for the intellectual and practical education of young men," designating the corporate name as "Terre Haute School of Industrial Science," and entrusting its administration to the corporators under the title of managers.

Instruction in the school was provided to be based on the practical mathematics and the application of the physical sciences to the various arts and manufactures, with other branches of active business, and was to include such training as would furnish the pupils with useful and practical knowledge of some art or occupation, and enable them to earn competent livings. Preference was to be given to students who were residents of Vigo county, moderate tuition fees were permitted to be charged, if considered necessary, and applicants for admission were required to be not less than sixteen years of age, and to be so prepared as to pass satisfactory examinations in the branches of a fair English education.

On October 10th, 1874, the Board of Managers was organized, by-laws were adopted, and the following officers elected:

President—CHAUNCEY ROSE.
Vice-President—JOSEPHUS COLLETT.
Treasurer—DEMAS DEMING.
Secretary—WILLIAM K. EDWARDS.

At the same time a committee, comprising Messrs. Cruft, Peddle, Hobbs, Jones and Collett, was appointed to consider plans for carrying into effect the objects of the association.

On the 12th of December the committee reported progress, and Messrs. Peddle, Cruft, and Jenckes were deputed to confer with an architect. One week thereafter Mr. Rose made his first donation, being a deed of conveyance of the ten acres of land now occupied by the Institute, and personal securities to the amount of $100,000. The committee on architect reported conferences with Mr. Isaac Hodgson, of Indianapolis.

December 26th Mr. Hodgson was elected architect, and Mr. Rose made a further gift of $86,000 in bonds of the Evansville, Terre Haute & Chicago Railroad Company.

By the end of January, 1875, the architect had prepared suggestive sketches, which were submitted to the consideration of Mr. Rose, and having met his approval, were adopted by the Board of Managers, and detailed drawings, with specifications and estimates of cost, were ordered to be prepared. * * * On the 9th of August, all preliminaries in the way of gathering materials, executing bonds and contracts, and the like, having been accomplished, Messrs. C. R. Peddle, Josephus Collett, and Charles Cruft, were elected a building committee, and Messrs. Cruft, Jenckes, Nippert, and Edwards were chosen as a committee on the laying of the corner-stone.

On the 11th of the following month the ceremony of laying the corner-stone took place, at 4 o'clock. An immense concourse of citizens of Terre Haute, and visiting strangers, marched in procession from the center of the city to the grounds of the School, to witness the exercises, over which Gen. Charles Cruft presided, by request of the Board. When the company had been called to order, prayer was offered by Rev. E. Frank Howe, pastor of the First Congregational Church, and a choir of mixed voices sang a selection. The corner-stone was laid by the architect, assisted by the contractors and their workmen, a metal box with numerous interesting memorials of the occasion, being deposited therein. The president of the day then introduced Col. William K. Edwards, who delivered an appropriate and eloquent address. A second musical selection was sung by the choir, and was followed by

a masterly oration by Barnabas C. Hobbs, LL. D. The benediction, by Rev. Mr. Howe, closed the exercises.

On the same day a meeting of the Board of Managers was held, and unanimously passed amendments to the articles of incorporation, which changed the name of the association from the "Terre Haute School of Industrial Science" to "Rose Polytechnic Institute." This alteration was not effected without persistent protest from the venerable founder; but the universal wish, not alone of his fellow-managers, but of the entire community of his fellow-citizens, that his noble benefaction should bear his own honored name, at length overcame his modest scruples, and he reluctantly gave his consent. Proper legal measures were also authorized to effect the transfer of the property of all kinds that had been received from Mr. Rose, from the Industrial School to the Polytechnic Institute.

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On the 27th of December Mr. Rose presented a statement of certain payments he had made for the benefit of the School, amounting to $31,255.66, with quittance in full thereof, and at the same time transferred the sum of $100,000 in certificates of preferred stock in the Evansville & Crawfordsville Railroad Company, as an addition to the endowment.

At the annual meeting, held on the 2d of June, 1877, Mr. Rose tendered his resignation as a member of the Board of Managers, in consideration of his great age and infirmities. In deference to his wishes, his fellow-members accepted it, but most unwillingly. Mr. Josephus Collett was elected to succeed him as President of the Board, and Mr. Charles R. Peddle was chosen as Vice-President. * * * Mr. Rose died on the 13th of August, 1877, and on the 17th of October, the vacancy occasioned by his resignation was filled by the election of Mr. William Mack.

The total of Mr. Rose's gifts to the Institute, prior to his death, reached the sum of $345,614.61.

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By his will a specific legacy of $107,594.34 was bequeathed to the Institute, and it was constituted his residuary legatee after the payment of his devises to his family, to the Rose Orphan Home and the Free Dispensary. What may be the exact amount to be derived from the settlement of the estate it is impossible to determine, but it is reasonable to estimate that the grand aggregate of his donations to the school will considerably exceed $500,000.00.

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Diligent inquiry had continued to be prosecuted also into the availability of candidates for the professorships of the faculty, and a number of eminent educators had been invited to visit Terre Haute and confer with the Managers upon the future organization and conduct of the School. Prominent among these had been Dr. Charles O. Thompson, Principal of the Free Institute of Technology, at Worcester, Mass., Prof. Wm. D. Marks, of the University of Pennsylvania, Prof. T. C. Mendenhall, of the Ohio State University, and Prof. F. W. Clarke, of the University of Cincinnati, from all of whom most valuable counsel and suggestions and hearty encouragement had been obtained.

Finding themselves, by the receipt of the specific legacy, possessed of funds which yielded an income of about $25,000.00, the managers felt that the time had come when they might take the necessary measures for opening the Institute. The first important step was the election of Dr. Charles O. Thompson, of Worcester, Mass., to the Presidency of the faculty. This occurred on the 20th of February, 1882, and the President of the Board, with the Secretary and Gen. Charles Cruft, visited Worcester for a personal conference with Dr. Thompson. Toward the end of March he accepted the appointment and immediately began the work of selecting a faculty and preparing a detailed plan for the organization of the School. Professors of chemistry, of elementary and higher mathematics, and of drawing, and the Super-

intendent of the Machine Shops, were chosen and accepted. Those whose services were necessary reported for duty as soon as their prior engagements admitted, and by the end of the summer of 1882, great progress had been made in the work of preparation. It was found that a small class could be provided for by the beginning of March, 1883, and in August of 1882, circulars were published inviting applications for admission. An opportunity for the purchase of the apparatus and library of the late Dr. John Bacon, of Harvard College, was availed of by the Board, and a most admirable collection of instruments and of scientific books was added to the resources of the School. Power, machinery, and tools for the Shop, were purchased by Mr. Edward S. Cobb, the Superintendent, under the sanction of a committee composed of Messrs. Peddle, Nippert and Cox; cases for the mineralogical specimens were constructed, after the plans of Prof. Charles A. Colton, of the Department of Chemistry, and the elegant collection was mounted, labeled and stored under his skilled labors. Shelving for the library, designed by Prof. Clarence A. Waldo, the future librarian, was provided, and the early purchases of the Board and the Bacon library were catalogued by the Secretary and arranged by members of the faculty. Large additions to the library and apparatus were made by President Thompson, who had sailed for Europe, in July of 1882, for study of the methods and progress of technological instruction in the more advanced schools abroad. Tables, easels, models, in brief, all the required appliances for the department of drawing, were procured upon the suggestions of Prof. William L. Ames, of that department, and, by the time anticipated, everything was in readiness for the opening. On the 6th of March candidates for admission were examined, and a class of twenty-five members selected from the most proficient.

On the 7th of March, 1883, the Inaugural Ceremonies were held and the educational work of the Institute formally began. (See Appendix X.)

The following is the brief announcement in the First Catalogue of the opening of the school, with the "four years course," concisely outlined. Full page plans of the five floors of the stately main building, and of the two floors of the shop building, are given.

The Rose Polytechnic Institute.

This Technical School, founded by the late Chauncey Rose, of Terre Haute, Indiana, is now open for the instruction of young men in technology.

In accordance with the directions of the founder, the Institute offers a good education based on the mathematics, physical sciences, living languages and drawing, and familiarity with some form of applied science or handicraft. The course of study is so planned that every student spends a fixed portion of his time in learning the elements of the business or profession that he designs to pursue after graduating; this part of his work is called practice.

Recitations, lectures, laboratory work and drawing are of uniform kind and amount for all students; exercises in practice are widely different, depending upon the department selected by the student. The general course of study does not differ essentially from that pursued in other Polytechnic Schools. The practice is offered in the following departments: Mechanics, Civil Engineering, Chemistry, Physics, Drawing and Design. The choice of a department is made by each student soon after entering, under the advice of the faculty. A department of Mining Engineering will be organized as soon as possible and duly announced.

APPARATUS FOR INSTRUCTION.

Recitation-rooms, lecture-rooms, laboratories and drawing-rooms are ready, ample supplies of models, plate, and laboratory equipments having been purchased. Field instruments for the use of Civil Engineers have also been provided.

A cabinet of minerals containing 5,000 specimens carefully arranged to facilitate the study of geology and mineralogy, is displayed in a room convenient for use.

A library of 5,000 volumes, selected with especial reference to the wants of students of technology, but not destitute of works of standard literature, is on the shelves and will be increased as occasion demands.

In the shop is an assemblage of rooms in which iron and wood-working tools and machinery, arranged with reference to instruction by means of construction, are provided for the use of students. The wood room, boiler and engine rooms are in order; the iron room and forge shop, will be in order before September 1, 1883, as all the requisite tools are now under contract; so that students in mechanics will enjoy the advantage of practicing in a large, well-lighted, manufacturing machine shop, which is equipped with the best modern tools and machinery. All products of the shop will be made for sale, and the labor of the students will be supplemented by that of skilled journeymen, who will finish the work under the inspection and for the instruction of pupils; the latter will thus be surrounded by the influences of actual business and under the incentive of emulation with practiced handicraft. In the equipment of the machine shop the sum of nearly $30,000 has been expended.

Plans for a new building to be devoted to the uses of a chemical laboratory, have been submitted to the trustees and the work will be begun early in the autumn. Ample provision has been made for the study of physics according to the most approved modern ideas.

COURSE OF STUDY.

The course of study occupies four years, and the work is arranged as follows (the figures indicate hours per week):

Freshman Class.—Free Drawing, 6; Mathematics, 7; Practice, 25; Private Study, 14. Total, 52.

Sophomore Class.—Free Drawing, 2; Mechanical Drawing, 6; Mathematics, 6; Language 4; Chemistry and Physics, 4; Practice, 10; Private Study, 20. Total, 52.

Junior Class.—Mechanical Drawing, 6; Mathemetics and Theoretical Mechanics, 4; Language 4; Chemistry and Physics, 4; Practice, 10; Private Study, 24. Total, 52.

Senior Class.—Mathematics, 5; Language and Ethics, 5; Physics, 3; Chemistry, 1; Engineering, 3; Practice, 10; Private Study, 25. Total, 52.

In this course the term *Mathematics* includes algebra, geometry, trigonometry, analytical and descriptive geometry, the calculus, theoretical and applied mechanics; *Physics*, heat, light and electricity, each abundantly illustrated; *Chemistry*, the study of the elements, the use of the blow-pipe and the outlines of wet analysis; *Drawing*, free hand work, perspective, orthographic and isometric projection, shades and shadows, and the construction of working drawings of machinery; *Language*, the German language, the English language and the elements of French.

In addition to the general studies now enumerated, lectures are given in geology. Exercises in determinative mineralogy are included in the chemical instruction.

Only such changes will be made in this course as experience may show to be desirable. Students pass from class to class only by passing the term examinations.

The practice of the students in chemistry and physics will be in the laboratories, of the civil engineers in the field and drawing-room, of the designers in the drawing-room, and of the mechanics in the work-shop; but, in order to give the civil engineers some knowledge of tools, their practice will be in the workshops for the first two terms of the Freshman year.

In short, it is the intention of the managers and faculty that nothing shall be lacking to give the students of the Rose Polytechnic facilities not surpassed in this country for acquiring a sound technological training.

ADMISSION.

Candidates for admission to the Freshman class must be at least sixteen years old, present certificates of good standing and pass examination in the following branches, viz: English Grammar, History of the United States, Geography, Arithmetic, and Algebra to Quadratic Equations. The entrance examination will take place on Tuesday, September 18, 1883, at half-past eight o'clock A. M., at the office of the President. At the same time and place, candidates for the Sophomore and Junior classes will be examined and must give evidence of fitness to join the desired class. The senior class will not be organized till September, 1884.

TERMS AND VACATIONS.

The first term of 14 weeks begins September 18, and closes December 23, 1883; the second term of 13 weeks begins January 2, 1884, and closes March 30, 1884; the third term of 12 weeks begins April 9, 1884, and closes June 29, 1884. Vacations of one week each occur after the first and second terms respectively, and of eleven weeks after the third term.

EXAMINATIONS.

All students are examined at least twice a year on the work of the year, and the result of these examinations determines their standing.

TUITION.

No charge for tuition is made to *bona fide* residents of Vigo County, Indiana. All others pay seventy-five dollars each per year. Every student, of whatever place of residence, pays an annual fee of twenty-five dollars for use of chemicals, breakage and contingencies. All bills for tuition and incidentals are payable in advance on the first day of each term.

BOARD.

No arrangements for board are made at the Institute. Students find excellent accommodations in private families at prices ranging from $4.00 to $5.00 per week.

All students who intend to apply for examination should make application in writing. Letters seeking information about the Rose Polytechnic Institute, should be addressed to

Pres't. CHARLES O. THOMPSON,
Terre Haute, Indiana.

The students admitted to the first class, March 6th, 1883, numbered Twenty-five.

LIST OF THE BOARD AND OF THE FACULTY IN 1883.

BOARD OF MANAGERS.

Josephus Collett, Esq., *President;* Charles R. Peddle, M. E., *Vice-President;* Samuel S. Early, A. M., *Secretary;* Demas Deming, Esq., *Treasurer.* Firmin Nippert, Esq., Hon. William Mack, Robert S. Cox, Esq., Preston Hussey, Esq., Hon. Richard W. Thompson, L. L. D, William C. Ball, A. M.

FACULTY OF INSTRUCTION.

Charles O. Thompson, A. M., PH. D., Late Principal of the Free Institute of Industrial Science, Worcester, Mass., President.

Charles A. Colton, E. M., Late Assistant to the Professor of Mineralogy in the School of Mines, Columbia College, New York, Professor of Chemistry.

Edward Barnes, B. S., Graduate Student of Johns Hopkins University, Professor of the Higher Mathematics.

Clarence A. Waldo, A. M., Late Assistant Professor of Mathematics, in Wesleyan University, Middletown, Conn., Professor of Elementary Mathematics and Librarian.

James A. Wickersham, A. M., Late Instructor in Kansas University, Professor of Languages.

—— ——, Professor of Physics and Theoretical Mechanics.*

—— ——, Professor of Engineering.*

Edward S. Cobb, B. S., Late Assistant Superintendent of the American Paper Bag Company, Boston, Superintendent of Machine Shop.

William L. Ames, B. S., Late Student at Cincinnati School of Design, Professor of Drawing.

While the statements of the first catalogue were comprised in eight pages, exclusive of those given to the floor plans of the buildings, the second annual catalogue contains 29 pages, exclusive of the same floor plans. This contains, also, a notice of the "manufactures of the Rose Polytechnic Shops" which are offered for sale in accordance with the precedent set by the shops of the Worcester Institute. The students are organized in three classes: Freshman, Sophomore, and Junior, and number 45; an increase of 20 in a single year. The third Annual Catalogue (1885), shows a total attendance of 69 students in the four classes. The "Senior Class" is given for the first time, numbering 3 students. In the Fourth Annual Catalogue, (1886) the name of President Thompson is starred with the simple note; "Deceased, March 17th, 1885."

The unlooked for death of President Thompson, in the fullness of his powers, produced a profound impression; and was felt, not only as a calamity to the new institution, but also, as a great loss to the educational forces of the country. His experiment at Worcester, and its further development at Terre Haute, which gave such assurance of exceptional success, had been followed with unusual attention by all interested in the evolution of the New Education; to which it was conceded that, by inventing this novel form of school, Dr. Thompson had made an original and important contribution.

An influential member of the National Council of Education from its organization, Dr. Thompson had freely contributed to the promotion of varied educational interests by numerous addresses, papers and publications. Dr. Barnard, in the pamphlet already quoted from, gives a list of some twenty-three titles up to the time of his assuming the Presidency of Rose Institute. Some of the topics are

* To be appointed.

"Drawing," "Manual Labor and the use of Tools," "Technical Education," "Handicraft in School." "The Polytechnic School," "The Worcester Plan of Technical Education." "Hints towards a Profession of Teaching," etc., etc. He was a member of various scientific societies. Charles Oliver Thompson, A. M., PH.D. was born September 25th, 1836, in East Windsor, Connecticut, where his Father, Professor William Thompson, D.D., was a professor in the Connecticut Theological Seminary. He fitted for College in the East Windsor Academy, under the late Paul A. Chadbourne, an inspiring educator who was subsequently President of the Massachusetts College of Agriculture. Graduating at Darmouth College, in the class of 1858, he spent his life, with the exception of a short term as a practical surveyor and civil engineer, in the work of teaching; first in the district schools, then, in the work at Arlington for four years, of successfully combining an English High School, and the old classical "Cotting Academy," into a new form of Public High School. From this work he was chosen, in 1868, as Professor of Chemistry, to the Worcester High School of Industrial Science; and commissioned to undertake a tour of some months in Europe, with the purpose on his return, of inaugurating a scientific and practical course of instruction, such as, at that time, "had no recognized type or model in this country."

His successful execution of this purpose at Worcester, and at Terre Haute, marks the opening of an educational era in the United States. Dartmouth College, conferred the title of PH. D., in 1870. The tributes called forth by the occasion of his untimely death, testified not only to the ability and culture of the scholar; but, also, to the catholicity of the educator, and the high character and loveable qualities of the man.

The same wise judgment and good fortune which was evinced in the calling of Dr. Thompson, to become the first President of the Institute; was again illustrated in the happy selection of his immediate successor.

We have seen that in the formative period of the new Institute, the Trustees frequently called to their aid for advice and counsel, four leading educators; one of whom was subsequently chosen to be the first President of the Institute.

They now turned to another of their former counsellors and asked him to assume the Presidency so sadly and unexpectedly left vacant; and Dr. Thomas C. Mendenhall, PH. D., LL. D., formerly Professor in the University of Cincinnati, later a Professor in the Imperial University of Tokio, Japan, and at this time employed in one of the scientific departments of the U. S. Government Service, was called to the chair. Dr. Mendenhall, entered on his new duties in the autumn of 1886, and remained in charge for four years; when he was again called to resume service under the Government, and placed at the

head of the U. S. Coast and Geodetic Survey, where he still remains. (1893).

Such official recognition of his unquestioned distinction as a scientist, furnishes the best endorsement of his success as an educator, and of his standing in the scientific world.—

His successful administration of the Presidency of Rose Polytechnic Institute, may be inferred from the fact that the total yearly attendance grew, from 67, as given in the catalogue of 1886, to 159, in the catalogue of 1890; which is the last issued under President Mendenhall.

Dr. Henry C. Eddy, C. E., PH. D., Dean of the University of Cincinnati, and for sometime the acting President, succeeded Dr. Mendenhall, as President of the Institute.

The continued growth and success of the school is shown by the statistics given in the catalogues since issued. From the latest one at hand,* the general statement of the purpose and methods of the Institute is here taken, together with the programme of the course in Mechanical Engineering, and that of the department of Drawing. The other "courses," in "electrical" and "civil" engineering, and in "Chemistry," are given in the catalogue in similar detail.

The Rose Polytechnic Institute, is devoted to the higher education of young men in Engineering. This term includes all those productive and constructive arts by which the forces and materials of nature are made subservient to the needs of man, together with the principles which underlie those arts.

The course of instruction at this Institute deals in detail with the principles and the practice of Engineering with special reference to the following branches of the profession: Mechanical Engineering, Electrical Engineering, Civil Engineering, and Chemistry, as based upon Drawing, Modern Languages, Mathematics, Mechanics, Physics, Chemistry, and Shop Practice.

The advances in scientific and technical education which have been made during the past two or three decades in Europe and in this country have been largely in the direction of the introduction of laboratory and practical training into courses of study which formerly consisted exclusively of text-book and theoretical work. So satisfactory have been the results of this innovation that it is no longer a question of debate. Engineering, in practice, is essentially the application of established principles for the purpose of accomplishing certain results, mainly included in the conversion of matter into useful forms and the utilization of the forces of nature. The proper training of an engineer should include, therefore, not only a study of principles, but also their application in accordance with established practice. He is thus fitted for more rapid advancement on entering his profession, and is saved from the many errors arising out of ignorance of methods.

In this Institute the student's study of principles is supplemented by constant practice in laboratory and work-shop. In the former he learns the use of instruments and methods of research, and is thus prepared to attack successfully and in a scientific manner such problems as are sure to present themselves to him in the practice of his profession. In the latter he is made familiar by actual contact with

* Eleventh Annual Catalogue of the Rose Polytechnic Institute Terre Haute, Indiana. With an outline of the course of study and the Plan of Instruction. 1893. Terre Haute, Ind.: Moore & Langen, Printers and Book binders. 1893. Pp. 50.

the nature and properties of materials of construction; the use of machines for the manipulation of these materials, the necessary limitations placed upon the products of machinery as to form and methods of manipulation; and to this is added skill in the use of tools and machines which will greatly enhance his power as an engineer in design and construction.

The work of the students in mechanical engineering is so distributed that they spend, on the average, fifteen hours per week in practice during the first year, and ten hours a week during the rest of the course. During this time they receive instruction from skilled workmen in the various departments, by whom their practice is constantly supervised.

Each student receives throughout his course six hours a week of instruction in drawing; by this discipline such perception of form and proportion is imparted to the student that, when he undertakes shop-work, he makes more rapid and satisfactory progress than one who has not had the advantage of this training. And each student, as soon and as far as possible, is required to make working drawings of every article that he produces, for the ability to make and to read drawings is an indispensable necessity to every engineer.

As the work-shop is educational in its character, and is managed solely for the advantage of the students, each is encouraged to make as rapid advancement as possible, and is not kept back by his fellows or by the financial necessities of the institution.

To these considerations in favor of a school-shop must be added another, which outweighs them all; that the student comes to the shop-work with his perceptive faculties, reason, judgment and taste, all under constant and careful training in other departments of the Institute; and also that his interest in the study of theoretical principles is greatly enhanced by the opportunity offered for their immediate application to various problems arising out of his shop-work.

In accordance with these general ideas, the Rose Polytechnic Institute offers to young men a good education based on Drawing, Mathematics, Mechanics, the Physical Sciences and the Modern Languages, together with a practical training in and a familiarity with some form of applied science.

Plan of Instruction.

Courses of Study.—Provision is now made for four parallel courses of study. These are:

1. Mechanical Engineering.
2. Electrical Engineering.
3. Civil Engineering.
4. Chemistry.

Each course occupies four years of three terms each. There are four classes: Freshman, Sophomore, Junior, Senior. The Freshman class enters in September, and entrance examinations for this class are held at the Institute in June and September.

The four courses are identical during the first two terms of Freshman year, but diverge after that. At the end of the second term every student elects one of these courses.

No student is permitted to elect any special or partial course. Every one must take full work in one of the regular courses.

Many subjects, such as Drawing, Language, Mechanics, Elementary Chemistry, and Physics, etc., are common to all the courses. In such subjects the recitations and lectures are attended by students in all the courses; their exercises during hours of practice are, however, widely different and are presented in detail on another page.

All members of the Freshman class practice in the wood-shop during the first two terms. During the third term those who elect Civil Engineering devote but eight hours to practice in the machine shop and the remaining hours of practice to Civil Engineering; those who elect Chemistry employ all their hours of practice in the chemical laboratory.

In practice and labratory work, each student working independently of others, advances as rapidly as possible. A certain standard of excellence, however, must be reached by all.

Recitations are an hour in length, and the classes are divided into sections, so that no more are in recitation at one time than will be consistent with thoroughness of instruction.

Students are expected to spend two hours of study, if necessary, in preparing each recitation, and time enough in preparation for lectures and exercises in drawing and laboratory to secure the best results.

Courses of lectures are given by the President, Professors, and others in Geology, Astronomy and other topics not included in the regular course of study. Students are required to take notes and to sustain examination on these lectures. Instruction in Physics and Chemistry is given largely by means of laboratory practice.

Thesis.—At the close of the year each member of the Senior class presents to the faculty a graduating thesis, in which he records the independent investigation of some subject congenial to his tastes, and included in the scope of his course. In order to afford time for the preparation of these, one week of each month after January of Senior year is devoted exclusively to this work. These thesis, with all the drawings which accompany or illustrate them, are preserved in the library of the Institute.

COURSE IN MECHANICAL ENGINEERING.

As preparatory subjects, this course includes Drawing, Modern Languages, Theoretical Mechanics, Physics, and Chemistry. In the more purely techanical part of the course, the various branches of Applied Mechanics form the most important subjects. The course embraces instruction by text-book, lecture, laboratory, and work-shop practice with special reference to the following branches: Practical Physics; the Properties of Materials and their bearing on the Design of Structures and Machines; the Dynamical Principles involved in the design and action of machines and structures; Steam Engineering; the general principles of Mechanical Drawing and Machine Design, etc.

Engineering Laboratory.—For the instruction of the students in the investigation and solution of problems in mechanical engineering a collection has been made of the best apparatus and appliances for this purpose. The following are examples: A 40-horse power Brown automatic engine, with distribution valves capable of independent adjustment and fitted with complete arrangements for taking indicator cards under widely varying conditions. This engine is fitted with an absorption dynamometer capable of absorbing its full power, and also with devices for indicating variation of speed during one revolution or due to variation of load. A 50-horse power compound high-speed Westinghouse engine. A Wheeler surface condenser, and Blake air pump, arranged to be used with either or both, or for testing either engine; steam engine indicators and automatic power meters. Tranmission dynamometers, of powers varying from one to fifty horse, arranged so as to be easily used with machine tools, dynamo-electric machines, etc. A Brackett cradle dynamometer especially designed for the study of dynamos and electric motors. Testing machines for determining tensile and torsional strength, shearing strength, cross-breaking strength and torsional stiffness, together with the various elastic moduli of the different materials of construction, such as wood, iron, stone, cement, etc. For these machines very complete and novel sets of indicating and recording

devices have been provided. Tool dynamometers for testing the work absorbed by cutting and boring tools. Traction dynamometers for determining the work done in drawing cars at different speeds on level and graded roads. Engine-testing devices for testing the balancing of locomotives while running, together with the quality of the track, etc. Several sets of apparatus for determining, by static and kinetic methods, the elastic constants of materials in small specimens. Accurate linear and circular dividing engines. Comparators for testing standards of length. Standard length bars; strong and sensitive balances; thermometers, pyrometers and calorimeters for steam tests; speed counters, indicators, etc.

Each member of the Senior class in the course of Mechanical Engineering designs one or more machines during the year, and furnishes complete working drawings of the same. These drawings are then used by them, with the assistance of the Freshmen, in making patterns, and by the other classes in making the machines.

An excursion is made each year by the members of the Senior class, if they so elect, to one of the large manufacturing cities of the country. The class is accompanied by one of the members of the faculty, and a special study is made of the most recent machinery and methods.

Shop Equipment.—The Polytechnic shops are furnished with the best modern tools and machinery for working wood and iron. The equipment of the wood-shops consists of thirty-six benches, sixty sets of carpenters' tools, wood-turning lathes, circular saws, jig-saws, band-saw, double-spindle moulding machine, panel-planer, Gray & Woods' planer, automatic knife-grinder, horizontal boring machine, etc.

The equipment of the machine shop consists of the following tools:

Sellers planer 25″x25″x8, Pond lathe, screw cutting, 26″x20′, same 22″x10′, Powell lathe 19″x10′, Washburn lathe 16″x8′, Flather lathe 16″x8′, Lodge & Barker lathe 18″x10′, Pratt & Whitney lathe 21″x10′, Fitchburg lathe 15″x6½′, Putnam lathe 15″x6′, Pratt & Whitney lathe 16″x8′, Ames lathe 16″x7′, and one 16″ swing 6′ bed turret lathe made in the shop, universal and independent chucks, polishing lathe, speed lathes, Brainard milling machine, with spiral and gear-cutting attachments, Hendey 24″ shaper, Bett's 40″ radial drill, Pond 32″ upright drill, emery wheels, buff wheels, grind-stones, drills, reamers, standard gauges, chucking reamers, squares, surface plates, and a full equipment of smaller tools.

The Forge-room—Is equipped with five Buffalo stationary blast forges, each furnished with power blast. There are also complete sets of swages, and other tools for doing all kinds of blacksmithing.

The Brass Foundry.—Students practice in brass moulding from a large variety of patterns and under the immediate supervision of a skilled moulder.

The Engine and Boiler Rooms—Contain a 40-horse power automatic engine, previously mentioned, and five boilers; this engine serves the double purpose of a motor and a piece of apparatus; it has a variable cut-off with four independent slide-valves, and represents the best American workmanship. The Westinghouse compound high-speed engine of 50-horse power is fitted to drive a set of counter shafting and speed cones for experimental and testing purposes. There are also in connection with this plant the necessary condensers, air pumps, feed pumps, injectors, inspirators, test gauges, speed counters, engine indicators, calorimeters, pyrometers, etc.

The boilers are connected so as to be used in every possible combination; arrangements have been made to weigh the coal and ash, and to measure the water used, and these rooms become available for studying problems in steam engineering by actual experiment.

The following is the outline of the studies and practice in this course:

Course in Mechanical Engineering.

Year.	First Term.	Second Term.	Third Term.
Freshman ..	Algebra (4 t); Geometry (4 t); Free-hand Drawing (6 h); Elementary Physics (2 t); English (3 t); Practice in Wood-shop (16 h).	Algebra (4 t); Plane Trigonometry (4 t); Mechanical Drawing (6 h); Elementary Chemistry (2 t); German (4 t); Practice in Wood-shop (14 h).	Algebra (4 t); Spherical Trigonometry (4 t); Free-hand Drawing (6 h); Elementary Chemistry (2 t); German (4 t); Practice in Machine-shop, Blacksmith-shop, etc. (14 h).
Sophomore ..	Analytical Geometry (4 t); Descriptive Geometry (2 t); Elementary Mechanics (2 t); Free-hand Drawing (6 h); Chemistry (1 t); Chemical Laboratory (4 h); German (3 t); Practice in Machine-shop, Blacksmith-shop and Foundry; Care of Boilers and Engines (10 h).	Analytical Geometry (4 t); Descriptive Geometry (2 t); Elementary Mechanics (2 t); Mechanical Drawing (6 h); Chemistry and Mineralogy (1 t); Chemical Laboratory (4 h); German (3 t); Practice in Machine-shop, Blacksmith-shop and Foundry; Care of Boilers and Engines (10 h).	Calculus (4 t); Descriptive Geometry (2 t); Elementary Mechanics (2 t); Mechanical Drawing (6 h); Chemistry and Mineralogy (1 t); Chemical Laboratory (4 h); German (3 t); Practice in Machine-shop, Blacksmith-shop and Foundry; Care of Boilers and Engines (10 h).
Junior.......	Mechanical Drawing (6 h); French and German (4 t); Calculus (4 t); Analytical Mechanics (2 t); Physics (2 t); Electricity (2 t); Practice in Machine-shop, Blacksmith-shop and Foundry (10 h).	Mechanical Drawing (6 h); French and German (4 t); Calculus (4 t); Analytical Mechanics (2 t); Physics (4 t); Practice in Machine-shop, Steam engine and general machine tool construction (10 h); Lectures on Astronomy.	Mechanical Drawing (6 h); French and German (4 t); Calculus (4 t); Analytical Mechanics (2 t); Physics (4 t); Practice in Machine-shop, steam engine and general machine tool construction (10 h).
Senior.......	Applied Mechanics (4 t); Thermodynamics (1 t); Chemical Technology (1 t); English Literature (3 t); Physical Laboratory (6 h); Machine Design (6 h); Engineering Laboratory (6 h); Steam Engineering (6 h); Practice in Machine-shop, steam engine and machine tool construction (8 h).	Applied Mechanics (4 t); Thermodynamics (1 t); Chemical Technology (1 t); Political Economy (3 t); Physical Laboratory (6 h); Machine Design (6 h); Engineering Laboratory (6 h); Steam Engineering (6 h); Practice in Machine-shop, making of standard tools, including forging, tempering, etc. (8 h); Thesis work (2 w).	Applied Mechanics (4 t); Thermodynamics (1 t); Chemical Technology (1 t); Constitution of the United States (3 t); Physical Laboratory (6 h); Machine Design (6 h); Engineering Laboratory (6 h); Steam Engineering (6 h); Practice in Wood-shop — Construction of patterns for foundry use from working drawings of machines designed by members of the class (8 h); Lectures on Geology; Thesis work (3 w).

* * * * * * *

Drawing Department.

Professors Ames and Kirchner.

The first and last terms of the Freshman and the first term of the Sophomore year are devoted to free-hand drawing. The work done includes model drawing and shading with pencil, crayon, brush and pen; sketching parts of or complete machines and pen drawing from photographs (chiefly of machines).

The course in mechanical drawing begins in the second term of the Freshman year with geometric drawing and simple projections; the problems being selected with special reference to their use in drafting. In the second term of the Sophomore year working drawings and tracings are made, followed in the third term by the theory and practice of shades and shadows and of isometric and perspective projections, with work in line and brush shading.

In the Junior year cam outlines are studied and the theory applied in the con-

struction of cams of various kinds. In gearing, the involute and cycloidal tooth are constructed and applied to spur, bevel and worm gears, using Grant's Teeth of Gears as a reference book.

The remainder of the year is spent in the study of machine movements and in elementary designing.

The growing use of the camera as a companion to the engineer's note book is recognized and enough time in the Senior year is devoted to the practice of photography to enable the student to expose and develop dry plates with fair success.

The study of descriptive geometry, which is continued throughout the Sophomore year, is valued chiefly for its direct bearing on the problems of the designer and engineer, consequently greater attention is given to such parts of the subject as may be oftenest applied in engineering practice.

All drawing is done under the eye of the instructor.

The course as arranged by year and terms is shown below.

Apparatus.—The Free-hand Drawing Room is elegantly finished and provided with examples of the most approved methods of drawing. It contains a collection of casts of antique forms made by Malpieri, of Rome, and a full set of the models designed by Walter Smith, of Boston.

The Mechanical-Drawing Room is equally commodious, and easily supplied from the shop with examples of Machine Construction. In this room the students will see specimens of the drawing and machine work done at other Polytechnic Schools, especially the large collection presented to this institution by the Imperial Institute of Technology at St. Petersburg.

DRAWING.

	First Term.	Second Term.	Third Term.
Freshman ...	Free-hand—Outline Drawing from Models Six hours per week.	Mechanical—Geemetrical Drawings and Projections. Six hours per week.	Free hand—Shading from Models with pencil and crayon. Machine Sketching. Six hours per week.
Sophomore..	Free-hand—Sepia and Pen and Ink Sketching and Drawing for Photo-Engraving.—Six hours per week. Descriptive Geometry—Point line and plane—Two times per week.	Mechanical—Working Drawings and Tracings—Six hours per week. Descriptive Geometry—Cone, Cyl. and Sphere—Two times per week.	Mechanical—Shades and Shadows. Isometric and Perspective Projections—Six hours per week. Descriptive Geometry—Warped Surfaces—Two times a week.
Junior.......	Mechanical—Problems in Stereotomy, Cam Outlines—Six hours per week.	Mechanical — Gear Tooth Outlines and use of Odontograph. Special Problems in Machines Movements—Six hours per week.	Mechanical—Elementary Machine Design and making working and finished Drawings—Six hours per week.

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BUILDINGS AND GROUNDS.

The Institute occupies a well-graded and sodded campus of ten acres, lying on Locust street between Twelfth and Thirteenth streets, in the city of Terre Haute, Indiana.

Three buildings have been erected, the Academic Building, Work-shop and Chemical Laboratory. The Academic Building is a handsome edifice of brick with stone trimmings, four stories high above the basement story; it contains forty-six rooms. The building is two hundred feet long, with terminal transepts sixty-four feet deep,

and central transept eighty. The Work-shop is also of brick, two stories in height, and contains ten rooms. The Chemical Laboratory is of brick, cruciform in shape, of one story and perfectly ventilated; it contains four rooms—qualitative, 39'x43'; quantitative, 22'6"x39'; balance, 6'x10'; office, 16'x21'.

This available space will probably receive important addition at an early day, from the bequest of $75,000 by the will of Josephus Collett, late President of the Board of Managers of the Institute, and its generous benefactor.

The statements of expenses, conditions of admission, etc., remain substantially as given in the first catalogue. The following is the total attendance for the year as given in the catalogue of 1893.

SUMMARY.

Graduate Students	3
Seniors	22
Juniors	27
Sophomores	41
Freshmen	71
Total	164

FACULTY OF INSTRUCTION. (1893.)

Henry T. Eddy, C. E., PH. D., 441 North Seventh St., *President.*

William L. Ames, B. S., 729 Ohio St., *Professor of Drawing and Descriptive Geometry.*

James A. Wickersham, A. M., 451 North Eighth St., *Professor of Languages.*

William A. Noyes, PH. D., 320 North Ninth St., *Professor of Chemistry.*

Malverd A. Howe, C. E., 637 Cherry St., *Professor of Civil Engineering.*

Carl Leo Mees, M. D., The Terre Haute, *Professor of Physics.*

Thomas Gray, B. SC., 318 North Seventh St., *Professor of Dynamic Engineering.*

Charles S. Brown, PH. B., 613 Mulberry St., *Professor of Steam Engineering and Machine Design.*

Arthur S. Hathaway, B. S., 1317 South Sixth St., *Professor of Mathematics.*

William H. Kirchner, B. S., The Terre Haute, *Junior Professor of Drawing.*

Edwin Place, B. M. E., 409 North Sixth St., *Instructor in Physical and Engineering Laboratories.*

Robert L. McCormick, B. S., 602 North Eighth St., *Instructor in Mathematics.*

Samuel B. Tinsley, B. S., 418 North Center St., *Instructor in Civil Engineering.*

William H. Kirchner, B. S., *Librarian.*

Mrs. S. P. Burton, *Registrar.*

Miss Hannah F. Smith, *Assistant Librarian.*

INSTRUCTORS IN THE SHOPS.

Charles S. Brown, PH. B., *Superintendent.*

Garrett W. Logan, *Instructor in Machine-work.*

William P. Smith, *Instructor in Wood-work.*

Thomas O'Loughlin, *Instructor in Forging and Tempering.*

Harry W. Dickinson, *Instructor in Foundry Practice.*

Benjamin Grosvenor, *Engineer, and Instructor in Engine and Boiler Management.*

The University of Illinois, Formerly Known as The Illinois Industrial University;—School of Mechanical Engineering.

The University was founded by a grant of public lands made by Congress for the establishment of colleges of Agriculture, and the Mechanic Arts.

It was chartered by the State in February, 1867, and was formally inaugurated March 11th 1868. It is both State and National in character, having received its endowment from Congress, and its equipment from the State with large donations amounting to more than $400,000 from Champaign County. In the autumn of 1871 the University was opened for the instruction of female students, and now it offers its advantages to all classes of society, without regard to sex, sect or condition.

LOCATION.

The University is situated in the City of Urbana adjoining the limits of the City of Champaign, in Champaign County Illinois. It is one hundred and twenty-eight miles from Chicago on the Illinois Central Railroad. The Indianapolis, Bloomington and Western Railway passes near the grounds."

BUILDINGS AND GROUNDS.

The domain occupied by the University embraces about 623 acres including stock farms, experimental farms, orchards, gardens, nurseries forest plantations arboretum, botanic garden, ornamental grounds, and military parade ground."

The University is well furnished with buildings, the main one being 214 feet in length with a depth on the wings of 122 feet. It is three stories in height with a mansard roof. The library wing is fire proof. This building is used for class rooms, library, chapel, hall, museums, etc., Another large building contains 80 dormitories.

The Mechanical Building and Drill Hall is of brick, 128 feet in length by 88 feet in width. It contains a boiler, forge and tank room; a machine shop, furnished for practical use, with a steam engine, lathes and other machinery; a pattern and finishing shop; shops for carpentry and cabinet work furnished with wood working machinery; paint printing and draughting rooms, and rooms for models, storage, etc.

In the second story is the large Drill Hall, 120 by 80 feet, sufficient for the evolutions of a company of infantry, or a section of a battery of field artillery. One of the towers contains an armorer's shop and military model room, an artillery room and a band room.

There are also Dwellings, barns and greenhouses. In addition to the Colleges of Agriculture, Natural Science, and Literature and Science, the University has a college of Engineering with separate Schools of Mechanical, Civil and Mining Engineering, and a school of Architecture.—Wood Carving and designing are also taught, though not in regular courses.

DRAWING.

Complete Courses in Geometrical and Projection, Architectural Engineering, Mechanical and Free-hand Drawing are given. Free-hand drawing is given by personal instruction in the execution with pencil and crayon, of "studies" by celebrated French and German artists, and in drawing from plaster models and other objects. The selections are made from a large and valuable stock purchased in Europe. Painting in Oil and Water colors will be provided for.

Modelling in Clay has been recently introduced as an adjunct study in the Architectural course. It is taught by an educated Sculptor, a graduate of the Fine Art School of Louvain in Belgium."

The School of Mechanical Engineering with the practice in the Machine Shops, assimilate this department of the University to the Worcester Free Institute, and the Sibley Mechanic College of Cornell.—

Accounts of the School of Architecture, and the Art Collection will be found under the appropriate heads. The regular course is one of four years and the studies are arranged as follows. [Recitations in studies not marked occupy one hour daily, figures, indicate the number of recitations in the study each week.]

COURSE 3.—MECHANICAL ENGINEERING.

First Year.

1. Advanced Algebra; Projection drawing; English or French.
2. Advanced Geometry; Free-hand Drawing, 10; English or French.
3. Plane and Spherical Trigonometry; Drawing and Clay Modelling; English or French.

Second Year.

1. Designing and Drawing 10; Advanced Descriptive Geometry and Drawing; French or German.
2. Shop Practice and Drawing 10; Analytical Geometry; French or German.
3. Shop Practice 10; Calculus; French or German.

Third Year.

1. Principles of Mechanism; Calculus; Principles of Chemistry; Vacation Journal and Memoir.
2. Analytical Mechanics; Physics; Shades, Shadows, and Perspective, 10.
3. Analytical Mechanics 3; Descriptive Astronomy 4; Physics; Chemical Laboratory Practice 10.

Fourth Year.

1. Resistance of Materials, and Hydraulics; Thermodynamics and Pneumatics; Geology or Mental Philosophy; Vacation Journal and Memoir.
2. Prime Movers, Millwork; Finished Machine Drawings, 10; History of Civilization; Experimental Physics 10.
3. Millwork and Machines; Designs and Estimates 10; Political Economy; Thesis.

DRAWING.

Projection Drawing—Use of Instruments in applying the Elements of Descriptive Geometry; Use of Water Colors; Isometrical Drawing; Shades and Shadows; Perspective. Free-hand Drawing—Sketches of Machinery; Ornamentation; Lettering. Machine Drawing—Working Drawings of Original Designs; Finishing in Water Colors, and in Line-shading; Details for Shop Use according to the practice of leading manufacturers.

PROJECTS.

The Designing, Drawing and Shop Practice, have always a definite practical purpose. The students under the immediate direction of teachers, carefully determine the dimensions and shapes best suited for the parts of some machine, reduce them to neat and accurate working drawings and make tracings for shop use. In the fourth year the drawings are completely finished with line-shading or colors and detailed according to the best methods. Specimen drawings are left for the use of the School. No student will commence his shop practice without working drawings. The designs are such as require execution in iron, brass and wood, for the

purpose of giving breadth of practice. The student is required to make the patterns and castings, finish the parts, and put them together in accordance with the working drawings and the required standard of workmanship. This acquaints him with the manner in which the Mechanical Engineer carries his designs into execution and teach him to so shape, proportion and dispose the parts of a machine as to secure the greatest economy of construction, and durability in use. Experiments in the testing of Prime Movers and other machines, are undertaken by the classes. They take Indicator Diagrams from the engine of the Mechanical Laboratory and determine from them the power developed with different degrees of expansion.

APPARATUS.

This School is provided with plates and a cabinet of models illustrating mechanical movements and elementary combinations of mechanism.

This collection is rapidly increasing by our own manufacture, and by purchase from abroad. A supply of Rigg's models has lately been added, and others from the celebrated model manufactory of J. Schroeder Darmstadt, Germany. About two hundred valuable models have been received from the United States Patent Office.

In the Pattern Shop are four complete sets of tools, benches and vises. In a separate building are forges, a moulder's bench with sand, and a brass furnace.

The number of students in the School of Mechanical Engineering for 1874–5 was 33. Tuition is free in all University classes.

The necessary expenses of students are given for 36 weeks as minimum 122.50 maximum 213.00.

Faculty of the College of Engineering. (1874–5.)

Regent and Professor of Philosophy and History.—Hon. John M. Gregory.
Professor of Civil Engineering.—J. Burkett Webb.
Professor of Mathematics.—Col. Samuel W. Shattuck.
Professor of Mechancal Engineering.—Stillman W. Robinson.
Professor of Chemistry.—Henry A. Weber.
Professor of Geology and Zoology.—Don. Carlos Taft.
Instructor in Free-Hand Drawing.—Miss Charlotte E. Patchin.
Instructor.—Ricker.
Assistant in Mechanical Engineering and Foreman of Machine Shop.—Elna A. Robinson.

LATER HISTORY.

There came a time when some of the officers and friends of this institution thought that its interests would be promoted by dropping the word "Industrial," and application was made to the Legislature of the State to authorize the proposed change in the name.

This, it seems, aroused opposition on the part of some who feared the proposed change of name, meant a radical change in the purpose of the institution, to result in its transformation into the formal classical college.

To meet this objection Dr. Selim H. Peabody, Regent of the University, addressed a memorial to the Legislature, a copy of which is made a part of his report to the Board of Trustees at their meeting July 1st, 1885.

From this, the following paragraphs showing the direction of the activity and growth of the institution in the line of technical industrial training, are taken.

EXTRACTS FROM MEMORIAL BY DR. PEABODY. (1885.)

1. As to students. In 1880, 60 per cent. of the students were engaged in technical courses, to 40 per cent. in other courses. In 1885, 68 per cent. are in technical courses, to 32 per cent. in other courses. As about 20 per cent. are women, nearly all of whom are in the literary courses, it follows that 68-80ths or 85 per cent. of the young men now in attendance are pursuing technical courses of study. Moreover, the essentially scientific character of the instruction is defended and guaranteed by law—a guarantee which no one seeks to remove. The law of 1873 prescribes that *each person* shall be taught and shall study such branches of learning as are related to "agriculture and mechanic," and consequently the Trustees have provided a list of such studies, one of which, at least, each student must pursue in each term of his residence at the University, and this rule is enforced.

2. As to the facilities for instruction. All advances made have been such as have aided the technical studies. Among these may be noted: The tools and machines in the shops have been duplicated during the last two years, and are yet insufficient. More will be bought with the next means furnished. The working space in both shops has been enlarged about one-third. A blacksmith shop has been added, and this may be changed at a half hour's notice, into a foundry, where the students are employed in molding and casting iron. A small observatory has been arranged for the use of instruments for advanced students in civil engineering. A dairy-house, for the proper handling of and experimenting on milk and cream. Laboratories for botanical, zoological, and microscopical work, have been arranged for the practical instruction of students in these several departments. The intent is to fully organize a school of mining engineering at the opening of the next year, and also to reorganize the department of veterinary science at the same time. We are doing all the work of a thorough school of pharmacy, except that of attendance behind the counter of an actual drug store. These and these only are the steps by which the present administration of the University is seeking to convert it into a "mere literary and classical college."

3. Much labor has been expended to bring the work of the University before the public by exhibits of its actual and practical results. These exhibits have been of its technical products, partly because these tangible things are more easily shown, but chiefly because we wished the public to see in these the leading work of the University. Many of you will remember the striking display made in the State House two sessions since. At the great educational congress held at Madison last year this University occupied a very prominent place with its manual training work alone. At New Orleans the University may claim to have done, with its varied and elaborate technical exhibit, more than any other interest, and almost as much as all others combined, to save the credit of the State of Illinois.

* * * * * * *

The founders and builders of this institution have honestly and earnestly labored to develop an institution which they have fondly hoped may be worth the affection, the pride and the support of the grand State of Illinois, and they have placed as its cornerstone—Scientific Education. This stone, which so many others had in a measure rejected, we have made the head of the corner. We have joined with it such other elements, as seem needful to a broad and wisely symmetrical culture. With no antagonisms, or jealousies, or heart-burnings, we are trying to show in this broad prairie land the virtue and the force of the "New Education." In this we shall claim no more of success than others are willing to concede to us. But

will not those who believe in the dignity and grandeur of scientific training consent that our and their University shall be as worthy of a noble name as those other schools which have built on the chief cornerstone of classical learning, but are themselves fast discovering from their and our experience, the equal if not superior power of scientific training in moulding and developing human and scholarly character?

THE GROWTH OF THE UNIVERSITY.

The catalogue of 1891–'92, the latest at hand, gives ample evidence of prosperous growth during the past decade. The general growth of the University in additional courses of study, and in increase in the number of Professors, and students, is amply shown in the abstracts from this catalogue given in the account of the University in the subsequent chapter, containing the Land Grant Colleges of Agriculture and the Mechanic Arts. The University is organized into four separate colleges as at the beginning; but, in each of these, courses have been added. The College of Agriculture, now has four separate courses. The College of Engineering has seven, namely: "Mechanical;" "Electrical;" "Civil;" "Municipal;" "Sanitary" and "Mining;" also a course in "Architecture" and one in "Architectural Engineering." The College of Science has two "Schools;" "Chemistry" and "Natural Science." The College of Literature, has three "Schools;" "English and Modern Languages;" "Ancient Languages;" "Philosophy and Pedagogy."

There is also a "Military School;" a "School of Art and Design;" and a Post "Graduate School." The process views of the interiors of the Work Shops and Laboratories, show that they are well equipped.

The following is the general statement of the training given in Mechanical Engineering.

MECHANICAL ENGINEERING.

OBJECT.

This course is designed to prepare students for the profession of mechanical engineering. It aims to fit them to invent, design, construct, and manage machinery for any branch of manufactures. There is a great demand for men who, to a thorough knowledge of the principles of machinery and of the various motors, add the practical skill necessary to design and construct the machines by which these motors are made to work.

INSTRUCTION.

The instruction, while severely scientific, is thoroughly practical. It aims at a clear understanding and mastery of all mechanical principles and devices. Practice in the workshop is required as one of the studies of the course.

In principles instruction is imparted by lectures, illustrated plates, and text books. Examples are given, showing the application of the theories and principles taught. Experiments in the testing of machines and motors are undertaken by the student.

In practice elementary forms are produced and projects are executed, in which

the student constructs machines, or parts thereof, of his own designing, and from his own working drawings.

In designing the student begins with elements and proceeds with progressive exercises till he is able to design and represent complete machines.

Equipment.

The mechanical laboratory consists of a large, well lighted machine shop, a pattern shop, a blacksmith shop, and a foundry.

The machine shop is supplied with twelve first-class engine lathes, ranging from twelve- to twenty-four-inch swing, ten hand lathes, two shapers, a planer, two milling machines, three drill presses, one punching machine, a Brown & Sharpe universal grinding machine, sixteen vises and the corresponding sets of bench tools. This shop is also provided with complete sets of standard guages, reamers, arbors, drillers, etc.

The pattern shop is provided with thirty-two benches, each supplied with a case of wood-working tools.

The blacksmith shop contains sixteen forges, fitted with power blast, sixteen anvils and sets of blacksmith tools.

The foundry is equipped with a cupola for melting iron, the necessary sand, ladles, flasks, etc., for making the castings which are afterward to be used in the machine shop.

The laboratory is also suppled with dynamometers, friction brakes, calorimeters, steam engine indicators, and other apparatus for carrying on mechanical laboratory work. A 50-horse power high speed engine, made by the students in the machine shop, furnishes power and is available for testing purposes. Three other steam engines, a gas engine, and several boilers of different makes furnish ample material for testing by the students in this department.

The detailed courses for each year follow, but they are substantially those already given in the account of the earlier years of the University. The general methods are as follows:

Mechanical Engineering.

1. *Shop Practice A.*—The course of elementary shop practice has been carefully arranged to familiarize the student with the forms of the parts of machines, and the mode of producing them. He is made familiar with all the ordinary cutting tools for iron or wood; with the form and condition for most effective work; with the machines and appliances by which they are put in action, and the instruments by which desired dimensions of product are obtained.

   (*a*) Exercises preparatory to pattern making in wood, consisting of planing, chiseling, boxing, sawing, turning, etc.; pieces are combined by mortise, dovetail, and glue joints. Finally, finished patterns are made.

   (*b*) Exercises in chipping and filing, in which true surfaces are produced with the cold chisel and file. After the hand and eye are sufficiently trained, fitting is begun, and the square, bevel, rule, compasses, and other auxiliary bench tools are used. Pieces are then fitted together by the file, with surfaces carefully finished.

   (*c*) Blacksmithing, including such operations as drawing, upsetting, punching, welding, tempering, etc.

   (*d*) Elementary exercises in machine tool work, in which the student becomes familiar with the various machine tools, such as engine lathes, shapers, planers, etc.

   (*e*) Exercises in molding and casting.

(*f*) Machine tool work executed with special reference to finish and sizes, using calipers, scales, gauges, etc. *Fall, winter, and spring terms*, 10 *hours a week.* Mr. ANDERSON.

2. *Mechanical Drawing and Construction.*—In this course the student is taught the methods peculiar to mechanical drawing. A complete set of drawings is made of some machine or parts of machines, and serves as working drawings for the shop work of the course. The time is divided between the drawing room and the machine shop. *Fall, winter, and spring terms*, 13 *hours a week.* Mr. ANDERSON.

   Required: General Engineering Drawing, 1, 2, 3.

3. *Mechanism.*—In this course the student takes up the parts of machines with reference to the production of required motion. The various forms of gear wheels, cams, link work, etc., are studied. Finished drawings are made, involving the more important problems. *Stahl and Wood's Principles of Mechanism.* Fall term, 10 *hours a week.* Professor SCRIBNER.

   Required: Math., 2, 4, 6.

There is a comprehensive "Museum of Industrial Art." Besides the specimens and examples pertaining to Agriculture, and to the Fine Arts:—

The Museum contains full lines of illustrations of the work of the shops; models made at the University or purchased abroad; drawings in all departments; Patent Office models, etc., samples of building materials, natural and artificial; a large collection illustrating the forestry of Illinois, Florida, and California; with whatever may be secured that will teach or illustrate in this most important phase of University work. The elegant exhibit made by the University at the Centennial and Cotton Exposition at New Orleans, finds a permanent abode in this apartment.

The Faculty of this College number 16 professors and instructors. Nine members of other faculties also give instruction in this College. Professor Nathan Clifford Ricker, M. Arch., is Dean of the College of Engineering. Thomas Jonathan Burrill, M. A., Ph. D., is acting Regent of the University.

MECHANICAL COURSES IN CORNELL UNIVERSITY.—THE SIBLEY COLLEGE OF MECHANIC ARTS.

The courses of Civil and Mechanical Engineering of Cornell, are similar to those of the other Scientific Schools of the country; which, from want of space, and as this is not solely a report upon technical instruction in Engineering, do not receive special description; the fact that a knowledge of drawing forms an essential part of the training of an Engineer being generally understood. Cornell, however, receives mention elsewhere in this Report, both on account of its School of Architecture, and also, because of its Art collections and Museums.

It claims notice in the present connection on account of its Department of Mechanic Arts, known as The Sibley College of Mechanic Arts. This department of the University closely resembles The Worcester Free Institute.

This is one of the departments for which the University is bound by the Land Grant to make special provisions. Professorships of Industrial Machanics, Civil Engi-

neering, Mathematics, and Practical Mechanics were early established and filled. Models illustrating mechanical movements, models of various classes of motion, and of engineering construction had been imported. A large amount of machinery had been acquired. But in 1870, the Honorable Hiram Sibley provided for the erection of a special building for this Department. He also gave ten thousand dollars for increasing its furniture, and has since enlarged his gift by a further donation of thirty thousand dollars for the same purpose. This department has thus been placed in a condition to do its work in the most satisfactory manner. There are now closely connected with the lecture room, in which the *theoretical* side of the Mechanic Arts is presented, other rooms for the designing and modeling of machinery, and workshops fitted with power and machinery for working in wood and metals, in which the *practical* side will be conducted.

The machine shop is to be conducted wholly as a means of instruction, and each student in the department will be required to devote at least two hours per day to work in the shop; so that he will not only get theory and practice combined, but he will also have opportunities to construct and use tools of the greatest precision. Each candidate for the degree of Bachelor of Mechanical Engineering will be given an opportunity to design and construct some machine or piece of apparatus, or conduct a series of experiments, approved by the department, such as promise to be of public utility. While the University does not propose to remunerate students for their labor, or guarantee any return except instruction, advanced students will be allowed, to a certain extent, to make tools or small articles of utility for themselves. But in all cases they must work from approved plans and by the consent of the director of the shop. Materials wasted, or tools injured, will be charged to the student wasting or injuring them.

Three courses of study have been arranged:—

(1) *A Four Years or Full Course*, upon the satisfactory completion of which the student will be entitled to the degree of Bachelor of Mechanical Engineering.

The entrance examinations for this course this year are the same as heretofore: but hereafter six books of Geometry in addition will be required.

Course in Mechanic Arts.*

FIRST YEAR.

First Terms.—Algebra (5); French or German (5); free hand drawing and shop practice (7).

Second Term.—Advanced geometry (5); French or German (5); free-hand drawing and shop practice (7).

Third Term.—Trigonometry (4); French or German (5); linear drawing, projections and shop practice (7).

SECOND YEAR.

First Term.—Analytical geometry (5); German or French (5) or (3); chemistry (2); experimental mechancs (2); shop practice (3½).

Second Term.—Calculus (3); Analytical geometry of three dimensions (2); German or French (5) or (3); chemistry (2); electricity and magnetism (2); shop practice (3½).

Third Term.—Calculus (5); German or French (5) or (3); electricity and magnetism (2); mechanical drawing (2); shop work (3½).

* "The figures indicate the number of exercises per week or their equivalent in hours counted towards graduation."

THIRD YEAR.

First Term.—Calculus (5); descriptive geometry (5); heat (3); rhetoric and composition (2); shop practice (3½).

Second Term.—Acoustics and optics (3); machine construction and drawing (4); principles of mechanism (5); rhetoric and composition (2); shop practice (3½).

Third Term.—Machine construction and drawing (4); steam-engine (4); mill work (4); shop practice (3½).

FOURTH YEAR.

First Term.—Designing machinery (4); machine drawing (4); water wheels, lectures, etc., (4); shop practice (3½).

Second Term.—Mechanics (5); physical laboratory practice (4); designing machinery (4); shop practice (3½).

Third Term.—Architecture (2); field practice and the use of instruments (3); special study (4); working draughts (4); shop practice and preparation of thesis (4)."

(2) *An Optional Course* under the direction of the Dean. In this course entrance examinations in Grammar, Geography, Arithmetic and Algebra through Quadratics are required. Attendance upon ten lectures or recitations per week or their equivalent, in addition to two hours daily shop practice, two hours daily in drawing, and the passing of the examinations at the close of each term, are necessary to remaining in the University.

(3) *A Special Course* has been arranged for such young men as have a fair knowledge of the machinist's or pattern-maker's trade, who desire to fit themselves for foremen or leading positions in their business. They may enter the department without passing entrance examinations; but they are required to devote at least five hours per day to shop practice and four hours daily to machine or free-hand drawing, and to take such other exercises as may be prescribed by the Faculty of the Department.

The instruction in shop practice embraces the study and construction of gearing and link-work, strength and proportion of parts, accurate surfaces (such as face-plates, straight-edges, right angles, etc.), shop accounts, management, etc.

On leaving the University a certificate of proficiency and attendance will be granted.

(4) The Sibley College.

The sum requisite for the erection of this edifice was the gift of one of the Trustees, the Honorable Hiram Sibley, of Rochester. The foundations were laid in the autumn of 1870, and the building was completed during the summer of 1871. It is of stone, and of the same general character as the other University structures. Designed for the Department of the Mechanical Arts, it affords accommodation to that department, and, temporarily, to the Department of Botany. On the first floor are the machine shop and the office of the University Press. On the second floor are the lecture-rooms of the professors of Industrial Mechanics, and of Botany and the Mechanical Museums. On the third floor are the mechanical and free-hand draughting-rooms. On the north side of the building is an engine-room and a stereotype foundry. The Sibley College was formally opened on Wednesday, June twenty-first, 1871, by the Governor of the State and the authorities of the University.

II. MACHINE SHOP.

The Machine Shop, in the west end of the Sibley College, is carried on for the sole purpose of giving instruction in practical work. It is supplied with lathes, planers and grinding machinery, drilling machine, shaping machine, a universal milling machine fitted for cutting plane, bevel and spiral gears—spiral cutters—twist

drills, with additional tools and attachments for graduating scales and circles and for working various forms and shapes. In addition to the hand and lathe tools of the usual kind and of the best quality, there are tools of the greatest accuracy—consisting of surface plates, straight-edges and squares of various sizes, a standard measuring machine, measuring from zero to twelve inches by the ten-thousandth of an inch, and a grinding machine in process of construction for producing true cylindrical and conical forms. These tools are for the purpose of manufacturing standard gauges in addition to their general use in the shop.

The machinery is driven by water power through the agency of "wire rope transmission," or by a steam engine in case of accident to the water power.

All students in the course of Mechanical Engineering are obliged to work a certain number of hours a week in this laboratory. The door in the rear leads to the engine-room. On the next story is, at the right, the lower draughting room of the department of Free-hand Drawing, which also occupies an apartment of the same size, directly over this, in the third story. Here will be found an interesting collections of casts, representing statues, busts, mouldings, bas-reliefs, friezes, capitals, groups of flowers and a great variety of other objects; they are copies of antiques in the British Museum and the Louvre at Paris. They are so arranged that the sketcher can control the light which falls upon them. The west room, on the second floor, is partly a lecture room for the professor of Mechanics and partly a model room. In the cases may be seen several hundred mechanical models. Among them the most noticeable are the series of Ollivier models, exhibiting the effects produced by intersections of curves and surfaces; many working models made at the College of Mechanics, in Chester, England; a series of models, executed by the mechanician Schröder, of Darmstadt, illustrative of mechanical combinations, of which those displaying the peculiarities of cog-wheel motion are of especial interest; and some exquisitely finished models of steam engines and their various parts. The drawings on the walls are those which in previous years have received prizes offered by the Sibley College. Up stairs, the room above this, is the Mechanical Draughting room, fitted with adjustable tables, which can be lowered and raised at will.

Number of students in Mechanic Arts as given in the University Register for 1874–75 was 49. The special Faculty of The Sibley College of Mechanic Arts consists of

The President of The University, Andrew D. White, L.L. D.

Dean, John L. Morris, M. A., C. E., Professor of Mechanical Engineering and Machine Construction.

William H. Anthony, Ph. B., Professor of Physics and Experimental Mechanics.

Rev. Charles Babcock, M. A., Professor of Architecture.

Estévan A. Fuertes, Ph. B., C. E., Professor of Civil Engineering.

James Edward Oliver, M. A., Professor of Mathematics.

Edwin C. Cleaves, Assistant Professor of Free-hand Drawing and of Mechanical Draughting.

John E. Sweet, Master Mechanic and Director of the Machine Shops.

Cornell University is, perhaps, the most notable of the single institutions called into being by the vitalizing influence of the Land Grant Law of 1862. It furnishes, also, one of the most impressive instances of the power of a single public spirited individual* to

* For a graphic showing of what Ezra Cornell, planned, effected and endured, in his efforts to create and sustain this novel Institution of learning, the reader is referred to the extracts from the Inaugural address by President Schurman.

serve his generation and to send his benefactions down the stream of time in ever widening flow; and, by the attractive power of example, to secure the coöperation of other noble, generous spirits, whose direct efforts in teaching and whose munificent gifts, have here so augmented the gifts and efforts of the original benefactors, that already the vigorous sapling planted in 1862, by Ezra Cornell, and Andrew D. White, has developed into a Banyan Tree Grove; wherein the names of a Sage, a McGraw, a Sibley, and a multitude of other willing givers, are enshrined. The small Experimental College first begun in 1868, which, for twenty years, under the guiding hand of its first President, the Hon. Andrew D. White; for seven years, under that of President Charles Kendall Adams; and now, (in 1893,) for a single year under the rule of President Jacob Gould Schurman, (for some time previous Dean of the School of Philosophy,) has prospered with vigorous growth; until, with its many departments and schools, and with its grand educational opportunities open to students of both sexes, it need not shrink from comparison with the oldest and best endowed of the American Universities.

It is because of the interesting features of its origin and of its representative character,—due to its varied development,—as one of the Institutions called into being by this beneficent law of Congress, that so much of space is here given to showing its present condition; so far as it has developed in the direction of those studies with which this Report is concerned.

The report,* made by President Adams to the Trustees, at the close of the last year of his administration, shows a remarkable growth both in the University as a whole, and in all its departments; especially is this apparent in the increased attendance on the Law School, and on Sibley College. The increase in the total number of post-graduate students is large, and illustrates the growing tendency everywhere apparent, towards special lines of study.

Speaking of the general condition of the University as a whole, he says:

To the Board of Trustees of Cornell University.

GENTLEMAN :—In submitting the seventh annual report of my administration as President of Cornell University, it is a pleasure to state that the year has been one of marked prosperity and growth. By the tables herewith submitted it will be seen that the number of students in attendance has been much larger than ever before. The increased requirements in all the technical schools, which went into effect in the Fall of 1891 for the first time, seemed to justify an anticipation that there would be a considerable falling off in the number admitted to those departments. But the number that came with the additional requirements were so large as to fill all the classes as full as our accommodations would bear. The largest

*Annual Report of the President of Cornell University for the Academic year, 1891–'92. "With Appendices containing the reports of the several Departments." Presented to the Trustees June 15, 1892. Ithaca, N. Y. Published by the University. 1892. Pp. 48 and 40.

additions to the ranks of the undergraduates have been in the School of Law, in Sibley College, and in the course in Arts. We have received students to advanced standing from fifty different colleges. This fact affords gratifying evidence of the favor with which the University is held by other institutions. Of the 89 students admitted from such colleges, 21 entered the freshman class, 25 the sophomore, 22 the junior, and 21 the senior. But still more striking is the fact that the number of graduate students upon our rolls during the present year has been 177, and of these no less than 164 have pursued graduate studies. Only two other institutions in the country can show so large an enrollment of this most valuable class of students. Last year the number was 113, while the year before it was only 84, and seven years ago it was only 34.

Taking up the several Departments in course—(the reports made by the heads of these to the President are given at length in the Appendices)—he thus refers to Sibley College:

The accompanying Report of the Director of Sibley College presents very fully the needs of that important part of the University. The appreciative response of the public and of the profession to the liberal equipment provided by the Trustees, seems likely to become a source of real embarrassment. The Experimental Laboratory, the Lecture-rooms, and the Museums are all so much over-crowded with material and students that the demand for more room at almost every quarter seems imperatively urgent. The subject invites and should receive the careful attention not only of the Trustees, but also of those friends of higher education outside of the Board who are interested in this branch of professional work. In the opinion of the Director, fully a million and a half of dollars could be advantageously used for the enlargement and fuller development of Sibley College.

In the course of the year the water power has been improved and strengthened by the building of a dam and the putting in of a new turbine wheel at the expense of some $11,000. The new triple-expansion engine procured at a cost of $10,000, has been put in its place and is an important contribution to the efficiency of the department. Large and important gifts have also been received from generous benefactors. The additions to the classes have been so great as to overfill all the rooms, and the University is confronted with the necessity of either restricting the number of students admitted and refusing to accept gifts of machinery, or, on the other hand, of providing without much delay for larger accommodations.

As is the case with all live, growing Colleges, the material needs of the institution, to meet the pressing demands upon it, seem always to outstrip the resources; no matter how ample these may have seemed.

Cornell, whose rapid growth makes ever new demands for increased accommodations and additional facilities, seems to have had no lack of liberal support during the seven years comprising the administration of President Adams; as appears from a series of Tables which are given; showing, in detail, the increase in productive funds and in the material equipment of the University, from August 1st 1885, to August 1st 1892. the period of his rule.

The additions to "Buildings," and "Equipments," made from the current funds of the University, amount, in all, to $706,709,15; while the total increase of values from all sources, aggregate $3,157,037,01.

The President, after paying a graceful acknowledgment of his indebtedness to the Trustees for all their kindness, and expressing

a hearty appreciation of the cordial co-operation shown by his colleagues of the Faculty, closes this story of seven years of prosperity, as follows:

At the end of my inaugural address I used these words:

"In my hopeful moments I try to forecast the future. I see in imagination these courses of study perfected and extended; I contemplate new departments added and developed; I behold museums and laboratories established and amplified; and, as the crowning glory of all, I behold a great library arising to filfill the provisions of a noble and unthwarted purpose. As I picture all these provisions, shedding their influence for good or for evil over the future generations of this State, and think of all their possibilities and promises, and see them in imagination, crowning these beautiful hills, I revently pray to God, that all the fruits of wisdom and benevolence may be vouchsafed to the people of this State, and that all our efforts may be sanctified to the building up of noble men and women, and the universal furtherance of all good learning, and of every form of Christian civilization."

As I look about me to-day, I cannot suppress a feeling of reverent gratitude that in the seven years that have since elapsed, so much has been accomplished for the fulfillment of this hopeful prediction. But of all, I rejoice that the University never before was in so good a condition as it is to-day; and in passing over the keys of office to my successor, I do it with the hope and the fervent prayer, that the prosperity of the past seven years may prove to have been only a harbinger and a preparation for even greater prosperity in the years to come.

CHARLES KENDALL ADAMS.

From the full report made by the Director of Sibley College, the following passages, which show its development on several lines, are taken:

REPORT OF THE DIRECTOR OF SIBLEY COLLEGE.

To the President of the University:

SIR: I have the honor to present herewith such facts as relate to the progress and operation of the several departments of the University as are grouped in Sibley College, and such statements of their present condition and needs as have been suggested by the various heads of departments to the Director.

The College, as a whole, has participated fully in the steady advance of the University, and has gained in numbers of students, in quality of its student-body, and in extent and effectiveness of its courses of instruction. Of the 1,500 students registered this year, as reported by the Registrar, something over five hundred are enrolled in Sibley College, and all the undergraduates, with possibly a dozen or less exceptions, in its regular courses. Of these, also, eighteen are graduate students in other courses, or from other colleges more usually, who are taking work as candidates for our first degree. About a dozen others are candidates for advanced degrees, usually in mechanical and electrical engineering. The total, some 525 in all, exceeds the number enrolled in 1890–91, by about 75, or fifteen per cent. The average numerical increase for the whole seven years of existence of the College in its present form has been nearly the same and the growth in its higher work and post-graduate courses, though comparatively small in numbers, has compared most favorably with similar changes in other departments and has been exceedingly gratifying; especially so when it is remembered that, until the organization of Sibley College at Cornell University, the facilities for higher instruction in engineering, in this department, were almost *nil* and that the advanced courses leading to higher degrees in engineering through lines of work involving the higher departments of applied science and essentially, those in scientific research, had been sel-

dom offered, if at all. The demand for this higher instruction in professional work, and the importance of it, has now been so well illustrated that it may be safely assumed that we have entered upon a period of permanent growth on this higher plane. The number of applicants for admission to these higher courses, is now constantly, rapidly, and healthfully increasing.

Sibley College was established as a school of professional study and practice in engineering, with the intention, on the part of the Trustees, as stated at the time, of developing graduate as well as undergraduate schools on a purely professional basis. In the limited time allowed, non-professional studies, even if appropriately forming a part of such a course, could not be taught without excluding essential parts of the professional course, even now in that sense incomplete and capable of further improvement. The course of change observed in its curriculum has thus involved the displacement of the limited and unsatisfactory lines of non-professional work, and their replacement by necessary elements of a complete and satisfactory professional course. These branches, well-taught in their place in the educational departments and schools, are now taken by the student before entering upon his professional course, and the result is coming to be seen in the better preparation of students coming to the College, their greater maturity, and their better education, as well as finally better professional instruction. The result will undoubtedly be the custom, on the part of the financially competent, of securing a good education first; then entering upon their professional preparation and training. Thus will be produced both a more cultivated man and a more successful practitioner. It is early, as yet, to draw very definite conclusions; but the longer experiences of the law schools, schools of medicine, and other professional schools, may probably be taken as fully confirming the above deductions. In the case of the young man without the means or the time required for the complete education of the complete man, it is now possible to go at once from the high-schools, presumably the extent of his reach before beginning to study for his profession, into the professional school, and there most efficiently expend the time and effort requisite to his successful entrance into his chosen field. Both classes are better able to accomplish their ends than when both education and professional training, attempted in a single school, were incompletely and ill-taught and measurably unsuccessful.

The Schools of Marine Engineering, Mechanical Engineering, and Electrical Engineering, are described at some length; then follow the accounts of these other schools of this College which are germane to this Report.

Department of Industrial Drawing and Art.

The Department of Industrial Drawing and Art has continued to progress at equal rate with the other departments of the college, its special advances being seen in the direction of art work, both pure and industrial. The number of students under instruction, as a maximum, has been about three hundred and sixty. Of these the larger number, about two hundred, have been in the freshman classes of this and other departments of the University. About one hundred students in the junior class have also been taught designing and drawing in this department. The Sophomore has no instruction in this branch and the Seniors are taken charge of by the professors doing the advanced work in design, in mechanical, electrical, and marine engineering, etc. The course has now been remodelled so as to extend continuously throughout the whole four years, and is expected to be thus rendered very much more efficient.

The special improvements of the year have been mainly in the changes resulting in a better distribution of the art work, and mainly as given students in architec-

ture and other outside courses. Mr. Willis has thus been able to carry on a good course of instruction in water color, Mr. Gutsell and Mr. Noyes in free hand and instrumental drawing, and the former, also, in decoration. Mr. Gutsell has erected his kiln and secured some admirable results in decorative work in pottery. It is now proposed to develop something useful in etching with the advanced students taking industrial art, which course has recently been entirely reconstructed.

The work of the Junior class is largely that of designing and under the immediate supervision of Assistant Professor Williams and Instructor Reid. They have effected important improvements in methods of instruction and of work, and have thus been enabled to do good work where, ordinarily, twice as many teachers would very probably be unsuccessful. The amount of work done throughout this department—and the same is measurably true of the whole college,—is very remarkable and unusual for so small a force of instructors. It would, however, be probably an advantage could we increase their number to double that at present on our list.

This department is, in some respects, more seriously in need of proper accommodations than any other. It is not as absolutely crowded out of doors as is the Department of Experimental Engineering; but its quarters are quite unsuited to its work. It is placed above the mechanical laboratory, where the rumble and jar of machinery continually in motion constantly disturbs the students at their work, both by distractions due to the noise and, even more seriously, by the actual shaking and tremor of the floor. It is practically impossible to do nice work. The building was built as an extension of the workshops, and not for present purpose. We have no suitable rooms for this department of the college, and the first requirement in putting up new buildings will be space and good rooms and light for this work. Probably no institution in the country is in such pressing need of suitable accommodations.

Department of Mechanical Arts.

The Department of Mechanical Arts has been pressed as never before, in all its divisions. It has handled between 140 and 150 students in its shops, as a maximum, usually; the figures reading thus:

Fall Term: Woodworking, 146; Forge, 139; Foundry, 140; Machine Shop, 96; Total, 521.

Winter Term: Woodworking, 145; Forge, 98; Foundry, 69; Machine Shop, 119; Total, 431.

Spring Term: Woodworking, 152; Forge, 64; Foundry, 70; Machine Shop, 111; Total, 397.

The decreasing figures from term to term is due to the crediting of vacation work, largely in the Fall Term. Students in these sections of the department have paid, in addition to their tuition fees and chemical laboratory charges, as in other courses, about $7,000, which is the tax against Sibley College work.

The head of this department. Professor Morris, reports the above figures to give, per student, an average of 273 hours work for the year.

The product of this work is seen, not only in the skill acquired by students in handling tools, and as mechanics, but also in the construction of valuable machinery, and in the saving of large expense accounts to the University by doing much of its repair and other work. The foundry has produced between $1200, and $1500 worth of castings in iron and brass, which would have cost the University nearly a thousand dollars more than was actually paid out, had it been bought in the general market. The product in the machine shop, in marketable work, or in saving to the University was still greater than in the foundry. In the wood shop, as in the other shops, a considerable amount of productive work was done in the construction of work benches, cases, tools, etc., in value amounting to large sums, with

corresponding saving to the University treasury. All this work was done without sacrificing the regular graded instruction of students or the systematic exercises which have made this instruction so efficient. Visitors familiar with such matters constantly express surprise at the rapidity and effectiveness of this system. The skill of students who have any natural aptitude for the work is a never-ceasing source of wonder.

The work performed during the year now closing has included some very interesting constructions and the beginning of more. Steam engines, lathes both iron-working and wood-working, steam-pumps, dynamos of various forms, and many minor constructions, have illustrated both the skill of the student as a workman, and his aptitude for design and proportioning. Some of the most valuable and satisfactory of all the apparatus of both the mechanical and the electrical divisions is the fruit of the inventive genius, the professional knowledge, and the manual skill of students.

In respect to space, this department is perhaps better accommodated than either of the others. It has, for the time, ample room and an equipment so complete that it will probably be able to keep up with the demands coming of further growth in large part by its own work: depending upon the University only for the purchase of important tools, and apparatus for the construction of which we have not the special facilities needed to do the work economically. When the needs of the departments of drawing and experimental engineering can be met, it will be able to make use of its own already provided space in the "annex," and can then probably handle a thousand students with little difficulty, so far as accommodations in the wood working and machine shops go. The blacksmith and moulding shops will need further extension. Both are well-filled already, and the classes sometimes even crowd them. With the six hundred students expected another year, or the year after, they will be more than crowded.

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As to the operations of the college as a whole, it will be seen from what has been stated above, that its growth has been very rapid during the seven years now expiring; that its progress, so far as can to-day be anticipated, is losing none of its striking features, either in rate of growth, in improving quality of the student-body, or of the courses of instruction, or in extent and magnitude of the opportunities offering to do that work which is the peculiar province of the University and of Sibley College. It has been raised from the grade of the mixed manual training and high school to that of a high-grade professional school prepared to give a good and a strong professional course to men, rather than ineffective tuition in both educational and professional studies to immature boys. Such students are now dropped out with great advantage to the college; which remains crowded with the higher class of men. The organization of the undergraduate departments may be considered as now substantially effected, and the period of organization of advanced special professional schools is begun. This, the work for which the director was especially appointed, has been deferred by the exigencies arising from the entirely unanticipated and extraordinary growth of the undergraduate departments. There is apparently no reason, except lack of pecuniary support, for longer deferring their special work. The extent of the college as now organized, with its great equipment and varied work, makes their formation possible with less cost and lower running expense than would be the case in any other University, probably, and for less than would otherwise be the fact here. In fact, these expenses will be very small as compared with extension in other directions. Large numbers of instructors will be demanded, and the employment of a specialist in place of a general instructor is the only difference of importance. In each graduate school, the numbers of students will be likely to be insufficient to pay the costs of their instruction. The

equipment will be supplied by the collections already existing, in large part, and new equipment will come largely from interested friends of the movement.

The really serious difficulty now facing us is that of finding larger space into which to expand. Until the State does its part, its duty under the agreement with the General Government, in providing the needed buildings, or until friends can be found in other directions to perform that work for the State and the University, further growth in this direction will be attended with such inconvenience as will be likely to seriously impair its work, and interfere most seriously with any attempt to take advantage of the wonderful opportunity now presenting itself to the University and to the College. The officers of the College have done their part, as would appear, with embarrassing efficiency—they can do no more and must leave this matter in the hands of those better prepared to meet the situation. They are helpless in face of the class of difficulties now presenting themselves.

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Very respectfully yours,

ROBERT H. THURSTON,
Director.

The latest catalogue of the University* at hand, in the description of the Departments, gives a general account of the departments in Sibley College, which begins as follows:

MECHANICAL ENGINEERING AND THE MECHANIC ARTS.

The Sibley College of Mechanical Engineering and the Mechanic Arts receives its name from the late Hiram Sibley, of Rochester, who between the years 1870 and 1887 gave over one hundred and fifty thousand dollars towards its equipment and endowment. It includes five departments: Mechanical Engineering, Experimental Engineering, Electrical Engineering, Mechanic Arts or shop-work, and Drawing and Machine-Design.

After an account of the three courses in Engineering, comes that of

The Department of Mechanic Arts.—The aim of the instruction in this, the department of practical mechanics and machine construction, is to make the student, as far as time will permit, acquainted with the most approved methods of construction of machinery. The courses are as follows:—

Woodworking and Pattern-making: This course begins with a series of exercises in wood working, each of which is intended to give the student familiarity with a certain application of a certain tool; and the course of exercises, as a whole, is expected to enable the student to perform any ordinary operations familiar to the carpenter, the joiner, and the pattern-maker. Time permitting, these prescribed exercises are followed by practice in making member of structures, joints, small complete structures, patterns, their core-boxes, and other constructions in wood. Particular attention will be paid to the details of pattern-making. Forging, Moulding and Foundry-work: These courses are expected not only to give the student a knowledge of the methods of the blacksmith and the moulder, but to give him that manual skill in the handling of tools which will permit him to enter the machine shop, and there quickly to acquire familiarity and skill in the manipulation of the metals, and in the management of both hand and machine tools. Iron-working: The instruction in the machine shop, as in the foundry and the forge, is

* The Cornell University Register December, 1892. "I would found an institution where any person can find instruction in any study." Ezra Cornell, Ithaca, N. Y. Published by the University. Press of Andrus & Church. Pp. 237.

intended to be carried on in substantially the same manner as in the wood working course, beginning by a series of graded exercises, which will give the student familiarity with the tools of the craft, and with the operations for the performance of which they are particularly designed, and concluding by practice in the construction of parts of machinery, and time permitting, in the building of complete machines which may have a market value.

Department of Drawing and Machine Design.—Freehand Drawing and Art: The instruction begins with freehand drawing, which is taught by means of lectures and general exercises from the blackboard, from flat copies, and from models. The work embraces a thorough training of the hand and eye in outline drawing, elementary perspective, model and object drawing, drawings from casts, and sketching from nature. The course in freehand drawing may be followed by instruction in decoration, in every industrial art, in designing for textiles and ceramics, in modelling, and in other advanced studies introductory to the study of fine art. Mechanical Drawing: The course begins with freehand drawing, and in the latter part of this work considerable time is expected to be given to the sketching of parts of machines and of trains of mechanism, and, later, of working machines. The use of drawing instruments is next taught, and, after the student has acquired some knowledge of descriptive geometry and the allied branches, the methods of work in the drawing-rooms of workshops and manufacturing establishments are learned. Line-drawing, tracing and "blue printing," the conventional colors, geometrical construction, projections, and other important details of the draughtsman's work, are practiced until the student has acquired proficiency. The advanced instruction given the upper classes includes the tracing of curves and cams, the study of kinematics on the drawing boards, tracing the motions of detail-mechanism, and the kinematic relations of connected parts. This part of the work is accompanied by lecture-room instruction and the study of the text-book, the instructors in the drawing-rooms being assisted by the lecture-room instructor, who is a specialist in his branch. The concluding part of the course embraces a similar method of teaching machine-design, the lecture-room and drawing-room working correlated in the same manner as in kinematics or mechanism. The course concludes, when time allows, by the designing of complete machines, as the steam engine or other motor, or some important type of machine. Students often make original designs, and not infrequently put on paper their own inventions.

Industrial Art.—Instruction in industrial art continuing through four years is arranged for students having a talent for such work, and desiring to devote their whole time to this subject. No degree is conferred, but certificates of proficiency may be given at the end of the course. Additional interest is given by occasional general and public lectures on the history of art and the work of great artists.

Special Students.—Special students are expected to follow as closely as possible a course of instruction in the Mechanic Arts planned with reference to their needs. This instruction does not lead to a degree. It is intended for students who are unable to pursue a complete preparatory and college course, but who may be able to undertake the work laid out for those intending to prepare themselves especially for superintendents of shops and establishments, and who are not likely to be called upon to do the work of the mechanical engineer, in designing, etc. It consists mainly of shopwork, drawing and elementary mathematics; but students sufficiently well prepared may also take other useful studies.

The buildings have already been described in the foregoing account. The main building is 160 feet in length by 40 in width, and three stories in highth; an additional building, 150 feet long by 40 feet wide, and two stories high, is given to the laboratories of experimental engineering. The "collections" of apparatus, machinery,

models, etc., of the college, are said to be of "exceptional extent, value, and interest."

> The collections of the Department of Drawing also include a large variety of studies of natural and conventional forms, shaded and in outline geometrical models, casts and illustrations of historical ornaments.
>
> The workshops are supplied with every needed kind of machine or tool, including lathes, and hand and bench tools, sufficient to meet the wants of one hundred and fifty students of the first year, in wood-working; in the foundry and forge, all needed tools for a class of over one hundred in the second year; in the machine shop, machine tools from the best builders, and a great variety of special and hand tools, which are sufficient for a class of one hundred and fifty in the third year, and hundred seniors and graduate students.

The Mechanical Laboratories are extensive and abundantly equipped, as are those of Electrical Engineering. For the details of the courses of instruction, the reader must be referred to the current catalogue of the University, which in these as in other features, is always advancing.

The summary of students in the University shows 1665; of these 203, are in the School of Law; 1245, are undergraduates; and 85, are special students; the rest are graduate students, and "Fellows;" of these last there are 18.—Of the undergraduates, 289 take Mechanical Engineering.

The whole number of teachers connected with the University are 145. Robert Henry Thurston, A. M., LL. D., Doc. Eng., is the Director of Sibley College, and Professor of Mechanical Engineering. Jacob Gould Schurman, D. Sc., LL. D., is President of the University, and Professor of Mental and Moral Philosophy.

The University of California, College of Mechanics, Berkeley, Cal.

The University of California was instituted by a law which received the approval of the Governor March 22, 1868, and instruction began at Oakland in the autumn of 1869.—On July 16th 1873, it was formerly transferred to Berkeley its permanent site. Besides a college of Letters, and a college of Medicine, the law requires the maintenance of five distinct colleges which are known as The Scientific Departments—and include The College of Agriculture, The College of Mechanics, The College of Mining, The College of Engineering, The College of Chemistry.

The studies in all these colleges for the first two years are nearly the same, the full courses are designed to occupy four years, the last two being the special studies of the school chosen.

The final report of President D. C. Gilman, March 23rd, 1875, states that—

> A Chair of Industrial Mechanics was instituted by the Board in the autumn of 1874, and was subsequently filled by the appointment of Mr. Fredrick G. Hesse,

of Oakland. Mr. Hesse was trained in a German polytechnic school, and was early engaged as a teacher in Brown University. He subsequently held a scientific appointment under the United States Government, but has resided for the last few years in Oakland, engaged in mechanical occupations, especially in the invention and improvement of some ingenious mechanical contrivances. It is rare to find a man qualified to fill the duties of a Chair of Industrial Mechanics, both by his scientific attainments, and by practical knowledge acquired in the shop, but Mr. Hesse is such a man.

Mr. John D. Hoffman was appointed in the autumn of 1874 instructor of Industrial Drawing.* He is an experienced engineer and draughtsman, who was trained in Germany, has had long experience in the construction of public works, especially in the service of the U. S. Government, and he is in all respects qualified to impart an exact knowledge of the most important art.

COLLEGE OF MECHANICS.

Instruction in the science of Mechanics has been given in the University by Professor John Le Conte since 1870, but for the further development of the College of Mechanics, two new instructors have been appointed recently—Professor Hesse and Professor Hoffmann; the former to give instructions in Industrial Mechanics, and the latter in Industrial Drawing. These gentlemen are regarded as qualified in a high degree to give efficiency to this part of the University. Professor Hoffmann's classes are already well organized, and he has begun a collection of diagrams and models which will prove very helpful in his work. An order has been sent to Darmstadt for a collection of Schroeder's models illustrative of the elements of mechanism, to be purchased at an outlay of $1,000, and their arrival may be soon expected.

In the College of Mechanics the chief object is to teach Applied and Industrial Mechanics. Special attention is given to Industrial Drawing, with the construction of Machinery as the principal object in view.

Mr. Robert E. Ogilby gives instruction in free-hand drawing, in drawing from models, in perspective, and in painting both in oil and in water-colors, to all students *not* in the Colleges of Letters, Mechanics, and Civil Engineering.

Students in the College of Mechanics are instructed in Instrumental drawing, and in accordance with the following schedule.

INDUSTRIAL DRAWING.

THIRD CLASS:—SECOND YEAR.

First Term.—Construction of geometrical problems relating to points, lines, circles, and polygons, and drawing of combinations of these problems to give practice in the use of instruments.

Second Term.—Drawing of problems in Descriptive Geometry, following the course given in this branch; practice in lettering for maps.

SECOND CLASS:—THIRD YEAR.

First Term.—Application of Descriptive Geometry to constructions of the Civil and Mechanical Engineer. Platting of field notes in surveying and leveling and mapping, following the course in Civil Engineering.

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* See Introductory Lecture on Mechanical Drawing, by Professor Hoffman. Appendix.

Second Term.—Application of Descriptive Geometry continued, with shades and shadows. Platting of road and railroad work, earth work, etc., following the course.

FIRST CLASS:—FOURTH YEAR.

First Term.—Construction of simple machines, screws, helical surfaces, teeth of wheels, gearing, etc.; examples of stonecutting and masonry construction.

Second Term.—Drawing of steam engines and machines, etc.; drawing of joints, framing bridges, roofs, etc., following the course.

Instruction is also given in free-hand drawing.

Students in the College of Civil Engineering are taught topographical and map drawing, in addition to instruction in instrumental drawing.

A Museum of Mechanical objects has been started in connection with the College of Mechanics, and a purchase made of the famous and excellent Auzoux mechanical models.—A collection of fifty-eight castings in brass has been given to this museum by W. T. Garratt, Esq., of San Francisco.

The University possesses a few objects of Art, and a small cabinet of coins and medals, which last contains over four hundred ancient coins, mostly Roman, about 300 modern coins, and 350 medals; among the latter is a rare, perhaps unique, medal of Bishop Berkeley, presented by Professor Allen of Cornell University.

In the Library are a number of works on art. There were 95 students in the five colleges of Science in 1875.

The Faculty of the College of Mechanics includes in addition to the President of the University, who is ex officio President of each of the Colleges, the following Scientific Professors.

Physics and Mechanics.—John Le Conte.

Industrial Mechanics.—Frederick G. Hesse.

Mining.—William Ashburner.

Botany, Zoology, and Geology.—Joseph Le Conte.

Chemistry.—Willard B. Rising.

Civil Engineering.—Frank Soulé, Jr.

Mathematics.—William T. Welcker.

Industrial Drawing.—John D. Hoffmann.

Assistant in Mechanics.—Edward A. Parker.

PRESENT STATUS OF THE UNIVERSITY.

From the latest Register of the University* at hand, the following statistics of the officers and students connected with the University in all its departments, are taken; these effectively demonstrate the extent of its development during the past decade.

As abstracts showing the courses in Drawing and the facilities for instruction in Mechanics, with an account of the Mechanical Labora-

* Register of the University of California 1891–'92. Berkeley; Published by the Regents of the University. 1892. Pp. 190.

tory, taken from the catalogue for 1890–'91, are given in the account of the University contained in the chapter relating to the Land Grant Colleges they are omitted here.

It will be seen by reference to the account there given, that ample provision is made for thorough instruction in drawing and in Mechanical Engineering, and that the facilities provided by the University for education in Science keep pace with the rapid development of the sciences. The catalogue for 1891–'92, contains a description of the new "Electrical Laboratory," which is fully equipped.

Various collections illustrating the Sciences, and arranged under twelve departments, are contained in the Museums. Among these are valuable examples in Ethnology, Paleontology, comprehensive Geology, Mineralogy, Botany, Zoology, Metallurgy, Agriculture, Cabinet Woods, and a valuable collection of a variety of models. Many of these collections are very full and comprehensive.

There are ten "Laboratories" and an Astronomical Observatory, for the use of the students. The famous Lick Observatory is officially connected with the University. The "Mechanical Laboratory," the description of which is given in connection with the Land Grant Colleges, furnishes excellent facilities for "Industrial" and "Technical Training."—The later catalogue shows that the equipment of this Laboratory had been largely increased.

Nine hundred and eighteen students are recorded as in attendance at the University, during the Academic year 1891–'92; 152 persons in addition were enrolled in "extension courses." Of the regular students, 529 are in the College of Letters, and Colleges of Science. The remainder are in the Professional and other post graduate departments; these comprise the Lick University, and the Colleges of Law, Medicine, Dentistry, and Pharmacy.

Nine students are in the College of Agriculture; 30 in the College of Mechanics; 32 in the College of Mining; 52 in the College of Civil Engineering. A total of 194 officers and Instructors are connected with the administration of, and the instruction given in, the University. Of these, 64 are enrolled as Professors, Instructors, etc., in the undergraduate Colleges of Letters and Science.

The Faculty of the College of Agriculture consists of twenty Professors in addition to the President of the University. The Faculty of the College of Mechanics consists of fifteen Professors in addition to the President.

Professor Irving Stringham, Ph. D., Professor of Mathematics, is Dean of the Faculty of Letters and of the Faculties of Sciences. Martin Kellogg, A. M., Professor of Latin Language and Literature, is President pro tempore. of the University.

AGRICULTURAL COLLEGES.

CHAPTER VII.

COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS ENDOWED BY THE NATIONAL LAND GRANT OF 1862.

Introductory to the account of the several colleges—The passage of the Act of Congress in 1862, creating the Land Grant Colleges—The provisions of the endowment—Discussions concerning the proposed institutions—Fortunate far-sighted views of the promoters of this Law—Active part taken in the preliminary stages of this movement by the Rev. Amos Brown, LL. D., of the People's College, New York, and by President Evan Pugh, LL. D., of the State College Pennsylvania. Careful study of the needs of institutions fitted for scientific training—Importance to this movement to Educators and to the scientific world—Prominent part taken in advocacy in Congress of this movement, by Hon. Justin S. Morrill, M. C. from Vermont—Immediate influence of the preliminary discussion in arousing the interest of educators and lovers of science—The methods in use by scientific schools of European countries carefully studied—Impetus given by the passage of this law to the new education—Eleven millions of acres of the Public Domain set apart for the promotion of Industrial Education—The study of Drawing a necessary feature in the courses in Engineering and Mechanics—No attempt is made in these chapters to give a full account of these colleges, as they were included in The Report on "Industrial Education," issued by this Bureau in 1883—Statements of the officers of these colleges, concerning elementary industrial training in public schools, freely quoted in the following chapters.

INTRODUCTORY.

In 1862, the Congress of the United States, in pursuance of the uniform policy of the government in providing for the educational interests of the people, passed an act entitled "An act donating Public Lands to the several States and Territories which may provide Colleges for the Benefit of Agriculture and the Mechanic Arts."

This act which became a law on the second of July, 1862, granted "to the several States" "an amount of land to be apportioned to each State a quantity equal to thirty thousand acres for each Senator and Representative in Congress, to which the States are respectively entitled by the apportionment under the Census of 1860." "Mineral lands" are not to be selected or purchased under the provisions of this act. The bill contained in all eight sections, prescribing the manner of selecting the land and many details in regard to the fund, which it is not necessary for our present purpose to quote. The purpose of this bill and the object sought to be obtained by this

grand appropriation, is set forth in the fourth section of the bill as follows; which section is here quoted verbatim et literatim from the law as found in the Statutes at large.

"SEC. 4. *And be it further enacted,* That all moneys derived from the sale of the lands aforesaid by the States to which the lands are appropriated, and from the sales of land scrip hereinbefore provided for, shall be invested in stocks of the United States, or of the States, or some other safe stocks, yielding not less than five per centum upon the par value of said stocks, and that the moneys so invested shall constitute a perpetual fund, the capital of which shall remain forever undiminished (except so far as may be provided in section fifth of this act), and the interest of which shall be inviolably appropriated, by each State which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

(37 Congress, Sess. II, ch. 130, 1862, page 504.)

IMMEDIATE INFLUENCE OF THE NEW LAW.

The passage of this law led to earnest discussions in the several States, and on the part of the officers of various educational institutions, as to the kind and character of the schools to be created by it, the inclusion of "the Mechanic Arts" and the terms expressing the general purpose of the law to be "in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life" gave a liberal scope which saved the new institutions from becoming mere manual labor farm schools, in which farmers boys should be taught only such matters as related to the daily routine work of the farm; which in the opinion of some was the purpose of the law.

Fortunately the wise advocates of the movement,—among whom were numbered many of the most advanced Educators, including also, Presidents and Professors of Colleges, several of whom came at their own cost and personal inconvenience to Washington, to urge that these new colleges be empowered to give the fullest training in modern science,—had, during the consideration of the bill by Congress, carefully guarded against any such limitation; and the result has been that in each State the needs of the people, the nature of their industries, and the facilities offered by the other educational agencies of the State, have shaped the form of the new institutions; so that, while no two of them are exactly alike, they, for the most part, are adapted, or are rapidly adjusting themselves, to their surroundings, and are endeavoring to do the work most needed by the communities in which they are placed. The agricultural, the mechanical, or the engineering features being each more or less prominent as the community is an agricultural, a manufacturing, or a mining community.

THE MODERN DEMAND FOR TECHNICAL TRAINING.

The marvellous developments of science during the last twenty years have led to a demand for the possession of technical knowledge on the part of chemists, civil and mining engineers, manufacturers, and architects, which could not have been generally anticipated at the time of the passage of this law. Fortunately as already stated, there were among its advocates and promoters, some who realized that a new era had dawned upon the world; and who, awake to the ever growing developments of scientific discovery, were far-sighted and wise enough to insist upon the inclusion of the two clauses in the law which gave power to these new institutions to adapt themselves to the new educational needs which had already arisen, or which might arise in the future, and, thus to provide not only for this new departure from the established educational tradition, but for any subsequent modifications, or additions thereto, which might become desirable.

These new Educational Institutions were thereby made flexible, elastic, and adaptable to new conditions; contrasting with the crystalized college of tradition, as modern complex machinery, impelled by the motive power of steam, or electricity, contrasts with the hand loom, and the ox cart, of the past. If it were possible I should be glad to enroll here the name of each one of those earnest educators and wise legislators, who aided in this grand patriotic movement.*

The Scientific Schools which have been created by this National Land Grant law of 1862,† have been potent factors in the great material movements of the past two decades.

IMPULSE GIVEN TO INVESTIGATION OF EDUCATIONAL METHODS.

The opportunity of establishing such schools which was given by the passage of this law, not only drew public attention in the several States to the new education but, by the demand thus created for a body of instructors for these new colleges, the whole subject of their establishment was brought to the attention of a large class of trained educators, and such an investigation of the nature of the education which the new discoveries of science, and the needs of developing the material resources of the country, demanded, and such thorough study of the appliances, methods, and training institutions, which were in operation in European countries, followed, as, in itself was

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*For notices of two among the first and most efficient promoters of the movement embodied in this bill—the Rev. Amos Brown, LL. D., of the People's College, New York, and President Evan Pugh, LL. D., State College, Pennsylvania,—See Appendix Z.

†By the law passed in 1890, Congress expressed its approval of these schools by adding to their fund $15,000 a year, to be increased to $25,000 by annual grants of $1,000. For the provisions of the law; see Appendix Z.

productive of great results. For the first time a large number of professional educators seriously investigated the needs of a special training for the large class of young men, who will be needed if this country is to keep in its scientific and industrial development abreast of the civilized countries of the world.

Not only were all the latest improvements in agriculture and the methods adopted in the foreign agricultural training schools minutely studied, but all the great Technological Schools of Europe, the famous chemical, mining, and polytechnic schools, were carefully investigated, and the problem, of how best to adapt the systems and methods that had proved efficient in the European countries, to the changed conditions existing in this country, was seriously considered by many of the ablest among the trained educators of the United States; so that, before the colleges themselves had been fairly established, the influence of this law had given a great impetus to the new education. A whole class of scientific instructors had thus been created by the coming together, from the different classical colleges, and from the ranks of citizens, of an enthusiastic body of men who had made the sciences their peculiar study.

These studies were thus at once exalted into an importance before unknown, and the advice of the newly associated scientific professors, was speedily sought by those engaged in new enterprises.

BENEFICENT INFLUENCE OF THESE NEW SCHOOLS.

From these bodies of trained scientific Professors, and from among the graduates of the schools founded by them, have come, many of the scientific discoverers, and the courageous captains of Industry, who,—by their patient investigations in search of knowledge, their inventive ingenuity in devising new methods for utilizing the forces of nature, their skill in directing the employment of capital and labor, often in ways and for purposes before undreamed of,—have made possible the varied and rapid development of the resources of this country which, during the past quarter of a century, have made it the marvel of the world.

It needs but a moment's reflection on the important part which machinery has assumed in the development of Agriculture alone,—in the sowing, harvesting, and moving of the immense crops of grasses, grains, and cotton, to realize the close connection between Agriculture and the Mechanic Arts, and to see how wisely the founders of the new colleges in naming them, chose their words.

It may be questioned whether the direct influence of any body of specially trained Professors, was ever so plainly to be traced, as is that of the men composing the first instructors of these new schools of science.

EARNEST ADVOCACY OF THE BILL IN CONGRESS, BY HON. JUSTIN S. MORRILL OF VERMONT.

This bill was so ably and persistently advocated by the Hon. Justin S. Morrill, of Vermont, then a member of the U. S. House of Representatives, that it became familiarly known as the "Morrill Bill." The part then taken by the now venerable Senator, who has since been so deservedly honored by his State by being six times chosen to be a Senator of the United States, is not the least of the many evidences given of his far sighted and liberal statesmanship during his exceptionally long congressional career, which, beginning in the 34th Congress, was continued in the House of Representatives through the 39th Congress, when he was first chosen to the Senate. It is evident that the passage of the law could not have been effected without the cordial and earnest co-operation of many in both Houses of Congress; all those of his colleagues who, in either branch of Congress, thus aided in promoting its passage may well congratulate themselves as having shown the truest statesmanship and in having given an enduring impetus to the prosperity of their country.—It may be, that in this, some of them "builded better than they knew," but it was surely not by accident that the saving clauses of that law were inserted, and to those who thus knowingly provided for the future welfare of their country a full meed of gratitude is due.*

The study of drawing is an essential part of all courses of instruction that relate to engineering, or the mechanic arts, and of all the scientific courses.

The ability to draw is, also, of such varied application and utility in practical experience, that it should form a part of the equipment of every educated farmer; so that this study must be included in the courses of all the schools of science, which, in most cases, the institutions which have grown up under this law, have become.

As, also, these institutions are practically the universities for which the training in the public schools of the country prepares the student who wishes an industrial, rather than a classical, education; and, as the system of industrial drawing, which it is sought to introduce as an integral part of the common school courses of study, forms one of the most direct and useful means of preparation for the advanced courses of the "Colleges of Agriculture and the Mechanic Arts," it has seemed proper, in this Report, to include an account

* "The country was in the midst of a terrible civil war, and it was not a favorable time to inaugurate a great movement for the promotion of the arts of peace, but that memorable Thirty-seventh Congress rose to a full comprehension of its duty, and by an act approved July 2, 1862, donated public lands to endow colleges "for the benefit of agriculture and the mechanic arts." By this act and its subsequent amendments, over eleven millions of acres of the public domain were set apart and consecrated to industrial education." "A Baccalaureate Address, by E. E. White, LL.D., President of Purdue University, June 4th, 1882."

of such part of the courses of study in these institutions as are embraced under the very general term of drawing. No attempt has been made to give here any adequate statement of the general equipment of these various colleges.* Such details of the courses in some of the different institutions are, however, given as may afford data for comparison between them, and, also, for comparing the thoroughness of the training given in the United States, in these branches, with that given in European schools of similar character.

As the officers of these colleges may be considered as qualified to speak with authority upon all matters directly connected with industrial education, and as they have peculiar advantages for judging of the value of such elementary education in the common schools, such utterances as they have publicly made upon these topics, have been here freely quoted.

To the list of these colleges founded in whole and in part upon the National Grant, is appended a list of other similar schools of science, in the United States, no details of their courses are however given; in all cases the study of drawing, whether included in other courses or not, is an essential feature of their courses in engineering.—The National Academies at Annapolis and at West Point are included in the list of the "Colleges of Agriculture and the Mechanic Arts," because they are directly under the control of the Government and must necessarily be included in any inventory of the appliances for industrial art education, including scientific and technical training, possessed by the United States.

The several colleges are arranged alphabetically by States simply for convenience in tabulation.

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* For a more comprehensive and complete account of these colleges; see Appendix "A," to the Report on "Industrial Education in the United States," by the Commissioner of Education. This Report was issued in 1883, and was prepared in response to a resolution of the Senate. (Senate Ex. Doc. No. 25, Forty-seventh Congress 2d session.)

CHAPTER VIII.

CONCISE STATEMENTS OF THE SEVERAL NATIONAL LAND-GRANT COLLEGES, TAKEN FROM THEIR OFFICIAL CATALOGUES, WITH SPECIAL REFERENCE TO THOSE COURSES IN WHICH DRAWING IS A REQUIRED STUDY.

INTRODUCTORY.

As has already been stated in the last chapter, which introduces these abstracts, there is no intention of giving here any full description of the resources of, or courses of study in, these Educational Institutions; because, first, much of this information has already been given in the Special Report on "Industrial Education in the United States," issued by this Bureau in 1883; and, secondly, because such details are, also, readily accessible in the official Catalogues and other publications of the Colleges themselves. *

The reasons for including in the present Report such abstracts as are here given were also stated. In retaining these abstracts prepared ten years ago, while adding those taken in 1893, from the latest Catalogues then at the command of the Editor, there is the purpose of showing, by the opportunity thus given for comparison, the growth and the tendency of the development of the study of Drawing in its industrial applications; as well as in its relations to thorough courses of Educational training in Science.

What has been the progress in each institution in developing this study of Drawing during the past decade, and what is the general result, taking these institutions "en masse?" Such comparisons, by their interest and importance, seem to justify the added space required.

* Those interested in comparing the courses of study in different colleges will find a valuable compilation of such courses in the Annual Report of the Commissioner of Education for 1888–'89. See pages 1224–1361 of that report. A brief table of Public Schools in which manual training is given follows. See pages 1362–1367 of same report.

Nothing as to the relative importance and rank of the several schools can be properly inferred from their order as given in these pages; since the arrangement follows that of the names of the States in which they are situated and is purely alphabetical. Neither has the relative space given to any institution, any bearing whatever upon the question of its ranking importance, as the space given is largely accidental; sometimes one feature of a school, and sometimes another, will be treated in a fuller or briefer manner, as this or that point seems more or less desirable to be shown; or, as it may happen to have been brought out in the Catalogues themselves. These statements are made because, formerly, in some cases, it has been erroneously thought that an expression of the relative importance of an Institution was thus intended; it is desired hereby, expressly to disclaim any such design.

ALABAMA: STATE AGRICULTURAL AND MECHANICAL COLLEGE: ALABAMA POLYTECHNIC INSTITUTE.

The State Agricultural and Mechanical College of Alabama is situated at Auburn, Alabama.

In this institution there are four regular courses for which Degrees are granted. These are 1st the Course in Agriculture with the Degree of Bachelor of Scientific Agriculture. 2nd. The course in Engineering, including the two departments of Civil Engineering with the degree of Bachelor of Civil Engineering, and that of Mining Engineering, with the degree of Bachelor of Mining Engineering. 3d. The course in Literature, with the degree of Bachelor of Arts and 4th. The course in science, with the degree of Bachelor of Science. Each course is of four years; for the first two years the studies in all the courses are the same; all students except those in the course in Literature may, however, elect to study the modern instead of the ancient languages. At the end of the 2nd year, the student elects the Regular Degree course he will attend. Drawing is studied by all students during the first two years except by those in the Course in Literature, who are not required to take it. In the course in Engineering alone it is obligatory through the whole four years.

In Civil Engineering, "This Course extends the Scientific Course in applied mathematics, embraces full instruction in regard to the construction of common roads, pikes, railroads, bridges, canals, improvements of rivers, harbors, &c." * * *

"*The Course in Drawing* extends through four years. During the first year the students practice linear and freehand drawing. In the second year the elementary principles of instrument drawing, embracing a course of orthographic and isometrical projections, shades and shadows, structural drawing and topographical delineation, are taught. This course is obligatory on the students of all the Courses, except the Courses in Literature.

During the third and fourth years, instruction in drawing is obligatory only on the students in Civil Engineering. In the former year the system of instruction embraces orthographic projections, isometric drawing, shades, and shadows, tinting

in India ink and colors, the practice of drawing in sketches of tools, the finished work of mechanics, bridges and other structures. In the last, or fourth year of the Course in Engineering, the students are taught perspective. They then cease to draw for mere practice, and use their graphical skill in machine construction, in making drawings of works visited in excursions to mines, furnaces, water, gas and railway structures. Plans, profiles, and sections of railroad surveys complete the course.

Drawing Instruments.—The instruments used at the College are the Swiss, which are preferred for their general excellence and moderate cost. The instruments, with the materials for geometrical and topographical drawing, cost from ten to twenty-five dollars. The student is advised to defer his purchases of drawing instruments and material until he comes to the College, when he will have the advantage of procuring them under the direction of the Professor of Drawing.

The Drawing Room is fitted up with all necessary arrangements. A full set of geometrical models is provided. A large number of photographs, lithographs and manuscript drawings—English, German and French—have been imported. They illustrate the following subjects: General Descriptive Geometry, Linear Perspective, Shades, Shadows, and Reflections, Masonry and Stone Cutting, Girders and Trusses of Wood and Iron; Furnaces, Boilers, Railroad Shops, Depots, Offices, Machines, and their details, shown in the conventional colors used in France and Germany.

A selection of portfolios in landscape, figures and classic subjects, and casts from the gallery of the Louvre in Paris, is calculated to meet the wants of students desiring to pursue a full course in freehand drawing."

The attention given to drawing is shown by the following schedule of studies and weekly recitations. The figures indicate the number of weekly recitations.

First Term—2 Linear Drawing—Second Term—2 Freehand Drawing: Third Class. First and Second Term—2 Topographical Drawing. Course in Civil Engineering. First Term—5 Bridge Drawing. Second Term—5 Sketches of Tools, of the Component Parts of Machines, and of Bridges and other Structures. In the 1st Class. First and Second Term—10 Plans, Profiles, and Sections of Railroad Surveys—Course in Mining Engineering—Second Class. First and Second Terms—2 Sketches of Tools, and Component Parts of Machines.

The following Text Books are used in the 1st Class. Davidson's Linear Drawing, White's Art Studies. 2nd Class. Davidson's Projections and Model Drawing. 3d Class. Smith's Linear Perspective. 4th Class. Mahan's Industrial Drawing. 5th Class. Smith's and Enthoffer's Topography, Warren's Machine Drawing. Church's Descriptive Geometry and Shades and Shadows.

The catalogue of 1880–81, gives a total of 182 students in attendance.

The following summary taken from the annual catalogue for the year 1891–'92,* will serve to show something of the development of the college during the ten years that have elapsed since the foregoing account was abstracted from the catalogue of 1881–'82.

The direction of this development may readily be infered from the fact that the title "Alabama Polytechnic Institute" has been

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* Catalogue of the State Agricultural and Mechanical College, Alabama Polytechnic Institute, 1891–'92. Auburn, Alabama.—Montgomery, Alabama: Brown Printing Co., Printers, Binders and Stationers. 1892. Pp. 88.

added to the former one of the "Agricultural and Mechanical College." The present catalogue is a handsome pamphlet of 88 pages illustrated with views and plans of the buildings, the following general statement prefaces the account of the several departments.

An agricultural experiment station has also been established in connection with this college and a weather Bureau for Alabama, by which the relation of this Educational Institution to the farming interests of the citizens of the State is still further emphasized.

CIVIL ENGINEERING AND DRAWING.

Prof. Lane.

CIVIL ENGINEERING.

The special studies of this department begin in the Junior class, and require a good knowledge of Algebra, Geometry, Trigonometry and Analytical Mechanics. They are as follows:

Junior Class.—Simple, compound, reversed and parabolic curves, turnouts and crossings, leveling, gradients, setting stope stakes, location and construction of common roads and railroads.

Senior Class.—Classification, appearances, defects, reasoning, durability and preservation of timber; classification and description of natural building stones; bricks and concretes; cast and wrought iron, steel and other metals; limes, cements, mortars and their manufactures; paints and other preservatives; classification of strains and a general mathematical discussion of the same; joints and fastenings; solid and open built beams; classification, construction and mechanics of masonry; foundations on land and in water; bridges and roofs of different kinds; their construction and strains determined mathematically and graphically; common roads, their coverings, location and construction; location and construction of railroads; navigable, irrigation, and drainage canals; river and sea-coast improvements. Theory and practice are combined in both classes.

TEXT BOOKS.

Junior Class.—Henck's Field Book for Railway Engineers, Gillespie's Roads and Railroads, Parson's Track.

Senior Class.—Wheeler's Civil Engineering. Von Ott's Graphic Statics.

DRAWING.

All the students of the Freshman and Sophomore classes are required to take Drawing; but only the students in Mechanics and Engineering in the Junior and Senior classes.

The Freshman class is taught linear and free-hand drawing. The Sophomore class is instructed in the principles of orthographic and isometric projections, shade and shadows, perspective and tinting. In the Junior class the instruction embraces a more extended course in orthographic and isometric drawing, perspective, shades and shadows and tinting; also sketches of tools and machines, plans, elevations and cross-sections of buildings and blue prints. The Senior class make topographical drawings and drawings of machines, roofs, bridges, etc., to different scales, and blue prints. Plans, profiles and sections of railroad surveys complete the instruction in this department.

TEXT-BOOKS.

Freshman Class.—Hitchener's Geometrical Note Book, Thorne's Junior Class in Mechanical Drawing, and Davidson's Model Drawing.

Sophomore Class.—Projections, Davidson's Practical Perspective, Keuffel & Esser's Alphabet.

Junior Class.—Davidson's Building Construction, Davidson's Drawing for Mechanics and Engineers, Plates belonging to the College, Keuffel & Esser's Alphabet.

Senior Class.—French, English and American Plates belonging to the College, Keuffel & Esser's Alphabet."

The Faculty and Officers of the College proper, number 31, including 13 "Assistant Instructors." The whole number of students is given as 255, of these 30 are in the "Sub-Freshman" class and 11 are "Graduates." 193 take Drawing, 152 Mechanic Arts, 35 Civil Engineering, 13 Electrical Engineering and 117 Agriculture. All the 225 students in the College classes, take English. Wm. Le Roy Brown, M. A., LL. D., is the President.

Arkansas Industrial University.

The Arkansas Industrial University is situated at Fayetteville, Washington Co., Arkansas. A largely attended preparatory Department is connected with the University. The pupils in this Department in 1880–'81 numbered 306, in the college proper there were 120. Eight classes of Degrees are conferred by the University; Bachelor of Arts, Bachelor of Science, Bachelor of Agriculture, Bachelor of Letters, Civil or Mining Engineer, etc.

Map drawing is taught in the preparatory department and Drawing is one of the studies required of the pupils fitting to enter the Scientific, Engineering, or Agricultural Departments of the University.

The catalogue for the year ending June, 1881, shows no agricultural, scientific or engineering students in the Senior class of 9, one agricultural and no scientific or engineering students in the Junior Class of 23, one scientific, three engineering and no agricultural students in the Sophomore class of 40 and two engineering and eight 'English Course,' no scientific and no agricultural students in the Freshman class of 48. In the Freshman class drawing is taught in the 'English Course' for the first two terms.

This gives a total of 15 students in four college classes who, according to the schedule of studies, are taught drawing; of these there were none in the Senior class, one, in the Junior, four, in the Sophomore, and ten in the Freshman class; five only, are pupils in Engineering.—

In the tabulated courses of study Drawing is required during the first two terms of Freshman year, in the five courses of "Agricultural," "Mining Engineering," "Civil Engineering," "Scientific," and "English." The third term, only pupils in Agricultural and Engineering take drawing. The term "Drawing" does not appear in any of the courses for the three last years of the college course; but is included under "Applied Mathematics." The following extracts are from the announcement of the course of Applied Mathematics.

For students wishing to pursue the Engineering Course, a course of special

training in English, French, German, Elementary Mathematics and Drawing has been provided, embracing two years in the Preparatory Department, and the first year in Collegiate department.

The School of Applied Mathematics is designed as the basis of the course in Civil Engineering and Mining Engineering. The work proper begins with the first term of the second or Sophomore year, and embraces a three years' course in the applications of Pure Mathematics to the solutions of such problems as are constantly presented to the practical engineer.

ARCHES, BRIDGES, ROOFS.

The general principles of the arch and its modifications are given, together with the calculations of its strength. The various kinds of bridges are discussed. Particular attention is paid to the forms of truss used in the construction of roofs. Students make the working drawings for different construction, and calculate the stability required in the various parts.

ARCHITECTURE.

This subject is devoted to the consideration of the different ancient orders and their modifications, with a brief history of the same. Special attention is given to the modern styles of public and private buildings. Plans, elevations and perspective drawings of various kinds of buildings are made by students.

DRAWING.

In this course the use of drafting instruments is taught, and the student is gradually led from the representation of simple objects to those more complex in form. Students in the course of civil engineering pursue this branch throughout the entire three years; for those in Mining Engineering the subject is not carried to the same extent. But in both courses it is as far as possible made parallel with the above mentioned branches. Each student is required to execute for himself such drawings as serve to impress the principles taught under the different subjects.

A commodious drawing room has been fitted up with the most approved style of furniture. But each student has to provide himself with suitable drafting instruments. The cost of such a set will be about fifteen dollars.

The catalogue for the year ending September 2nd, 1889,* is the latest at hand; from this it appears that new buildings have been added and the facilities of the University largely increased.

The statement is made that the "General Assembly," by act approved March 30th, 1887, gave liberal appropriations for strengthening the Agricultural and Mechanical Departments of the University, and directed that all State "beneficiaries" should pursue one of these courses. Ample provisions are made for full courses in Manual Training, evidently a new departure. One thousand students, called "beneficiaries," are entitled to be sent by the counties to the University; these are distributed *pro rata* among the counties. In case a county fails to send its quota, the Governor of the State may fill vacancies.

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*Seventeenth Catalogue of the Arkansas Industrial University, Fayetteville, Washington Co, Ark., for the year ending September 2, 1889, and announcement for 1889-'90. 1889: Woodruff Printing Co., Little Rock, Ark., Pp. 117. Illustrated.

The following is the account of the Buildings, full page views of which are given:

UNIVERSITY BUILDINGS.

The main University building is a magnificent structure of brick, three stories in height, with a stone basement and mansard roof. It occupies three sides of a quadrangle, and has a frontage of 214 feet.

In the north wing are situated the Chapel on the first floor, the Library on the second, and the Engineering Drawing Room on the third; in the south wing, the Preparatory Hall on the first floor, the College Hall and Drafting Room on the second, and the Museum on the third.

The main front of the building is divided into offices, recitation rooms, and laboratories. The offices of the President and the Commandant, and the rooms of the Preparatory and Musical departments are on the first floor, the Departments of Mathematics, Engineering and Physics, Ancient and Modern Languages, and Pedagogics, have convenient rooms on the second floor, while the Departments of Agriculture and Chemistry and Biology and Geology, are accommodated on the third floor. Above, on the fourth floor, are the commodious and well-furnished halls of the Literary societies.

This building covers an area of 26,108 square feet, and contains *seventy* rooms, together with broad corridors and ample stairways. As a safeguard against fire, and to insure uniform temperature, the entire building is heated throughout by steam.

The new Dormitory, in accordance with legislative enactment, was erected by the Board of Trustees in 1887, and opened to the use of students in the Spring of 1888.

It is a substantial brick building three stories high, containing over forty rooms. In finish and appearance, both externally and internally, it is a model structure. The rooms are large, airy, well ventilated and lighted, and open into broad corridors extending lengthwise through the building. The entrances are five in number, three in front, which open upon a broad veranda, and two in the rear. As to location and drainage, every precaution has been taken to insure good health to its occupants. That proper care may be exercised a member of the teaching body resides here with his family, and the University Faculty make a regular tour of inspection. In this building the *electric light* has been substituted for kerosene lamps, and a source of danger is thus eliminated.

The building of the Agricultural Experiment Station is of brick, one story in height. It contains the office of the Director, the apartments of the Chemist, Horticulturist, Veterinarian and Entomologist, together with a commodious Chemical Laboratory, Weighing-Room and Store-Rooms.

The new Shop Building was erected in the Spring of 1889. It is of wood and iron, 170 feet long, 40 feet wide, and one story in height, with ample light and ventilation. The Wood-Room is 40 x 60 feet in size, the Metal-Room 40 x 40 feet, the Forge-Room 40 x 25 feet, and the Foundry 40 x 45 feet.

Connected with the Department of Agriculture is a large Barn, Stock-Shed, Dairy-House, Fruit-House, and other necessary outbuildings.

In the summary of the number of students in the various courses a total attendance of 529 is recorded. A large proportion of these are in the Preparatory Department. The "A" class numbering 148; the "B" class 136; "Irregulars not classified," 13; "Musical," 25; the "sub-Freshman-class of 1893" number 118; giving a total in the Preparatory Department of 442.

In the college proper there are 49 "Freshman-class of 1892"; 20

"Sophomores"; 9 "Juniors"; 7 "Seniors", "Class of 1889"; and 2 Post Graduate students. A total of 87 students.

There is here noticeable a steady diminishing ratio of attendance from the large number in the primary preparatory class, to that of the two Post Graduates.

The studies taken, show a marked change from those given in the catalogue for 1881, since, among the 9 seniors of that year, there were none who took either the courses in Agriculture, Science or Civil Engineering; while there are, among the 7 Seniors of the class of 1889, three studying for the Degree of Bachelor of Science and two for that of Civil Engineering. Among the 9 Juniors, class of 1890, there are two studying for the degree of Bachelor of Science and four for that of Civil Engineering.

Of the 20 Sophomores, class of 1891, two take the course in science and six in civil engineering. Of the 49 Freshmen, nine take the course in science, nine in civil engineering, three in mechanical engineering, and two in scientific agriculture. The remaining students are scattered among the courses for the eight different degrees offered by the college.

In all the "courses" the afternoons are given to "practical exercises," and among these, "Drawing" and "Military Drilling," are features of every course.

The following is the announcement of the Department whose studies include of necessity Drawing and Manual Training.

"Department of
Mechanic Arts and Engineering.

J. M. Whitham, Professor.
W. E. Anderson, Adjunct Professor.
G. P. Eustace, Instructor in Metal Work.
A. C. Hoag, Instructor in Wood Work.
R. F. Beardsley, Instructor in Forge Foundry.
A. G. Taff, Instructor in Field Engineering.

Courses of instruction are offered in

1. Manual Training.
2. Mechanical Engineering.
3. Civil Engineering.

1. COURSE IN MANUAL TRAINING.

The course in Manual Training, covering four years, is intended to prepare young men to obtain employment in the machine shop, forge and foundry, and at the wood-worker's bench. It replaces the old apprenticeship system, and, at the same time, gives the youth instruction in English, mathematics, science, drawing, the principles of mechanism and steam engineering. The recent growth of Manual Training Schools, not only here, but in Europe, is phenomenal. The apprenticeship system is now practically obsolete; hence the need of Manual Training Schools. The only opportunity offered to the youth of the State to obtain this instruction is given here.

Theoretical instruction given in the morning is indicated on page 35. That of the afternoon consists of practice for five hours a week in drawing, and ten hours in the training shops.

TABLE SHOWING THE DISTRIBUTION OF TIME IN HOURS IN THE MANUAL TRAINING COURSE.

Subjects.	Class. A.	Sub-Freshman.	Freshman.	Sophomore.	Total Hours.
English History, etc.	390	247	130	86⅔	853⅔
Science	......	143	130	86⅔	359⅔
Pure Mathematics	130	130	130	130	520
Applied Mathematics	......	......	130	216⅔	346⅔
Shop Work	390	390	390	346⅔	1516⅔
Free-Hand Drawing	195	195	......	......	390
Mechanical Drawing	......	.....	195	195	390
Laboratory Work	......	......	......	43⅓	43⅓
Total Theoretical Work	520	520	520	520	2089
Total Practical Work	585	585	585	585	2340
Total Work	1105	1105	1105	1105	4420

The subjects taught in the Training Shops are—1, carpentry and joinery; 2, wood turning; 3, cabinet making and practical carpentry; 4, pattern making; 5, foundry work; 6, forging; 7, metal fitting; 8, machine tool work; 9, care of steam machinery. The distribution of these subjects throughout the four years is shown in the following:

SCHEME SHOWING COURSE OF SYSTEMATIC INSTRUCTION IN WORK-SHOPS.

Class.	Section.	First term.	Second term.	Third term.
A	A	Principles of Carpentry and Joinery.	Wood Turning, ½ term. Practical Cabinet and Carpentry Work.	Practical Cabinet and Carpentry Work.
A	B	Wood Turning, ½ term. Principles of Carpentry and Joinery, ½ term.	Principles of Carpentry and Joinery, ½ term. Practical Cabinet and Carpentry Work.	Practical Cabinet and Carpentry Work.
A	C	Principles of Carpentry and Joinery, ½ term. Wood Turning.	Principles of Carpentry and Joinery, ½ term. Practical Cabinet and Carpentry Work.	Practical Cabinet and Carpentry Work.
Sub-Freshman.	A	Forging.	Forging, ½ term. Foundry Work, ½ term.	Foundry Work.
Sub-Freshman.	B	Foundry Work.	Foundry Work, ½ term. Forging, ½ term.	Forging.
Freshman.	A	Foundry Work.	Pattern Making.	Metal Fitting.
Freshman.	B	Metal Fitting.	Foundry Work.	Pattern Making.
Freshman.	C	Pattern Making.	Metal Fitting.	Foundry Work.
* Sophomore.		Machine Tool Work—engine lathe, planers, drilling machine, milling machine, etc.	Machine Tool Work—engine lathe, planers, drilling machine, milling machine, etc.	Machine Tool Work—engine lathe, planers, drilling machine, milling machine, etc.

* One student from this class is with engine and boiler.

Junior and senior students have an advanced course in the various shops.

EQUIPMENTS OF THE MANUAL TRAINING SHOPS.

The Training Shops are located in a new building, and are conveniently arranged and well equipped. There are four principal shops, viz: The Wood-working, Foundry and Molding, the Forging and the Machine Shops; also, there are other rooms auxiliary to these, as the Engine and Boiler-Rooms, the Tool-Room, Cloaking Room, Finishing Room, and Supply Rooms. In equipping these shops, those institutions of a similar nature were studied, compared and improved upon as much as circumstances would permit.

The Wood-Working Shop is equipped with eighteen well appointed work benches with tools, seven turning lathes, one double circular saw, one scroll saw, one band saw, one reversible shaping machine, one planing machine, and one steam glue heater.

The Equipments of the Forging Shop at present consist of nine forges of the most improved design, nine anvils, and nine set of tools, consisting of hand-hammer, tongs, calipers, steel rule, steel square, hot and cold cutters, file, flatter, fullers, swages, punches, heading tools, etc. The forges are supplied with power blast, a No. 6 Buffalo blower serving for this purpose. This shop has, also, a double emery grinder.

The Moulding-Room and Foundry are equipped with a Collan cupola which will melt from 200 pounds to one ton of iron at once, one brass furnace, nine sand troughs and moulders' benches combined, nine sets of moulders' tools, consisting of heart and square trowel, slickers, rammers, riddle, flask, swab, water pot, shovel, lifters, drawer, spikes, etc., six ladles from 100 to 5 pounds capacity, an assortment of flasks, and other necessaries for a complete foundry.

The Equipments of the Machine Shop are thirteen work benches with vises, sets of tools and closets, one twelve-inch engine lathe, three fourteen-inch engine lathes, one nineteen-inch lathe, one speed lathe, one planer, 24 x 24 x 72 inches, one planer 10 x 10 x 24 inches, one Universal milling machine (B. & S.), one double-wheel emery grinding machine, one drill press, one grinding stone, and chucks and other appliances for use on the lathes, planer, etc. Each machine has its distinct set of tools. This shop is well equipped with hammers, steel rules, steel squares, spring dividers, chisels, twist drills, taps, tap wrenches, die stocks, reamers, pipe dies, files of all sizes and shapes, wrenches, arbors, lathe-dogs, squares, scales, calipers, (inside and outside), machine and hand-cutting tools, a surface gauge, a Victor micrometer caliper, a protractor, and many other tools. The machinery is driven by a 25 horse-power Westinghouse engine.

CAPACITY OF THE SHOPS.

Fifty students can be accommodated in the shops at one time, divided among the rooms as follows:

Wood-working Room	24
Metal-working Room	18
Forging-Room	9
Foundry	9
Tool-Room	1
Engine and Boiler-Room	1

The Boiler-Room contains two horizontal fire tubular boilers set in brick work, aggregating 65 horse-power. These are used for heating the main building and running the shops. This room also contains a pressure-reducing valve, an automatic heater-trap and governor, Blake pump, gauges and other necessary appliances.

II.—COURSE IN MECHANICAL ENGINEERING.

Mechanical Engineering may be defined as being the application of mathematics to Science, with particular reference to the *design and fabrication* of all forms of machinery. Since engineering is the combined science and art of utilizing the forces and materials of nature, and since this utilization is accomplished in nearly all cases by machines, or by processes working through machines, it is evident that *mechanical engineering is the basis of all art and industry.*

The course of study is published on page 37. It is based on the belief that a mechanical engineer should be a mathematician, a scientist, a draughtsman and a mechanic. The course extends over six years, and consists of 3,120 *hours devoted to theoretical, and* 3,510 *hours to practical instruction.* The distribution of time among the several branches, both theoretical and practical, is shown in the following:

TABLE SHOWING DISTRIBUTION OF TIME IN HOURS IN THE MECHANICAL ENGINEERING COURSE.

Subjects.	Class.						Total Hours.
	A.	Sub-Freshman.	Freshman.	Sophomore.	Junior.	Senior.	
English History, etc	390	247	130	86⅔	......	......	853⅔
Science	......	143	130	173⅓	130	86⅔	663
Pure Mathematics	130	130	130	130	130	......	650
Engineering Studies	......	......	130	130	260	433⅓	953⅓
Shop Work	390	390	390	303⅓	43⅓	390	1906⅔
Drawing	195	195	195	195	97⅓	195	1072⅓
Surveying, Practice	......	......	......	86⅔	......	......	86⅔
Laboratory Work	......	......	......	......	444⅓	......	444⅓
Theoretical Work	520	520	520	520	520	520	3120
Practical Work	585	585	585	585	585	585	3510
Total Work	1105	1105	1105	1105	1105	1105	6630

In addition to the above, students may take French and German as elective studies.

The courses in Mechanical and Civil Engineering differ only in the work of the Junior and Senior years. Even during these years many subjects are included in both.

III.—COURSE IN CIVIL ENGINEERING.

Civil Engineering, as here understood, embraces the location and construction of railroads, canals, waterworks, sewerage systems, foundations on land and in water, tunnels and superstructures; the surveys, improvements and defenses of coasts, harbors, rivers and lakes; the application of mechanics, descriptive geometry and graphics to the design and construction of arch bridges, roofs, trusses and suspension bridges; the design and fabrication of wind, hydraulic and electric motors, and air and heat engines; irrigation and drainage of lands; and the preparation of forms of specifications and contracts.

The course of study, published on page 39, is believed to compare favorably with that in many of the older institutions of technology. It is decidedly a *practical* course, and the graduate is well equipped for the duties of an engineer. He is,

also, an excellent draughtsman and mechanic. The time in *hours* devoted to heoretical and practical instruction is shown in the following:

TABLE SHOWING DISTRIBUTION OF TIME IN HOURS DEVOTED TO STUDIES IN THE CIVIL ENGINEERING COURSE.

Subjects.	Class.						Total Hours.
	A.	Sub-Fresh-man.	Fresh man.	Sopho-more.	Junior.	Senior.	
English History, etc.	390	247	130	86⅔	......	......	853⅔
Science	......	143	130	173⅓	216⅔	86⅔	749⅔
Pure Mathematics	130	130	130	130	130	......	650
Engineering Studies	......	......	130	130	173⅓	433⅓	866⅔
Shop Work	390	390	390	260	......	260	1690
Drawing	195	195	195	195	65	195	1040
Surveying, Practice	......	......	......	130	216⅔	130	476⅔
Laboratory Work	......	......	......	......	303⅓	......	303⅓
Total Theoretical Work	520	520	520	520	520	520	3120
Total Practical Work	585	585	585	585	585	585	3510
Total Work	1105	1105	1105	1105	1105	1105	6630

In addition to the above, students may take French and German as elective studies.

While these pages are in the hands of the printer the catalogue for the year ending December 3rd, 1891, is received. This shows conclusively that the progress noted in the catalogue of 1889 continues.

The statement is made that "the University is at the head of the public educational system of the State of Arkansas." The constant effort is asserted to be to bring it in closer relations with the public schools, and to give "to all youth of either sex, ample facilities for acquiring a liberal education in literature, science and the industrial arts, and for the professional studies." Tuition is free except in the medical college.

The organization of the University is given in detail. It consists of the six "schools" at Fayetteville; these include Agriculture; Mechanics Arts and Engineering; Science; Liberal Arts; The Normal School; The University High School. There are sixteen separate "courses," which come under one or another of these schools. The "elective" system prevails with some restrictions.

The School of Medicine is situated at Little Rock. The Branch Normal College, for the training of teachers for the colored public schools, is at Pine Bluff. There are three "courses" at this school; viz: Normal; Classical and Mechanical.

As already shown much attention is given to Manual Training at Fayetteville. This is alike in all courses for three years; in the fourth year, the instruction is specialized; as the pupils elect either to fit for some Mechanical trade; to become practical operators of steam engines, or electrical plants; or wish to become Instructors of Manual Training.

The total attendance at Fayetteville is 573; of these 155 are women. The students in the College proper number 115.—Of these 5 are Post Graduate; 10, Seniors; 12, Juniors; 28, Sophomores and 60 Freshmen. There are also a number of students in music, elocution, law, etc. The Preparatory Department numbers 425. There are 113 students of Medicine at Little Rock.

There are 215 pupils at the Branch Normal College at Pine Bluff.

Total number of students in the various departments of the University 901.

The list of "Officers of Instruction and Government," Professors, Assistant Professors, Instructors, Librarians, etc., at Fayetteville numbers 36. Edward Hunter Murfee, A. M., LL. D., President and Professor of Psychology and Ethics.

UNIVERSITY OF CALIFORNIA.

The University of California situated at Berkeley, California, includes under its "Colleges of Letters and Science" eight regular courses of four years each, leading to a degree.

The Courses in Science: Agriculture, Mechanics, Mining, Engineering, and Chemistry lead to the degree of Bachelor of Science, and are founded for training those who wish to prepare themselves for the industrial professions. Each college gives to the student a good English education, such instruction in either French or German as will insure a reading power of one of the modern languages, and an introduction to the principles of modern science, together with special instruction preparatory to a fuller course of professional study in the particular department he may choose. Neither Latin or Greek is required for these courses, but a preparatory course in Latin is recommended. * * *

The Course in Mechanics is designed for students who wish to become mechanical engineers or machinists (so far as they are constructors of machinery), or to devote their energies to such technical and industrial pursuits as involve a knowledge of machinery.

The Course in Mining is designed for students who wish to become mining or metallurgical engineers, or to engage in one of the many pursuits connected with the mining industries, such as the surveying and mapping of mines, the assaying and working of ores, the designing and use of mining machinery, or the exploitation of mines.

The Course in Engineering is designed for students who wish to adopt civil engineering as a profession, and to engage in such work as the survey of lands, leveling, topographical engineering, triangular or geodetic surveying, the location and construction of roads, railways, and canals, the designing and construction of bridges of wood, iron, or stone, the building of dams, reservoirs, and systems of water supply, drainage, and sewerage, and the improvement of rivers, harbors, and sea coasts.

In examination for entrance to the Literary Course "Free hand drawing," is among the six studies, proficiency in any two of which, in addition to eight prescribed studies, is requisite for admission. It does not appear from the Register that drawing is among the re-

quired studies in the Literary or other courses except those of Mechanics and Engineering already named.

In the College of Mechanics,

Department of Drawing.

The instruction in this department is a direct application of the course especially in Graphostatics as applied to the analysis of stresses in roof and bridge structures, and in the designing of simple machines, water-wheels, etc.

In the College of Mining,

Mechanical Drawing and Construction.—These are made, as far as possible, an application of the course in Mechanics to Mining Engineering. Instruction is given in Designing Machinery and Fixed Structures for mining and metallurgical work.

In the College of Civil Engineering:

Object of the College.—The object of this College is to give thorough instruction in those studies which pertain to the profession of the Civil Engineer. To a very considerable extent, these studies are likewise preliminary to the profession of an Architect. They are also serviceable to all who wish proficiency in the application of Mathematics and Physics.

Special Instruction in Engineering begins with the Surveying Course in the Junior year, and includes Land Surveying, Leveling, Topographical Surveying, Use of the Plane Table, Road and Railroad Surveying and Construction, and computations of earth-work required by excavations, tunnels, and embankments. A large amount of time is allotted to practice in the field, and to the use of instruments, such as the compass, level, field transit, plane table, etc., and to the working up and plotting of field notes. Topographical drawing and mapmaking are taught in connection with this part of the course. During the present year an accurate topographical survey has been made, by the class, of the ground immediately surrounding the University buildings. This will be mapped by them, and the work continued by successive classes till the entire tract shall have been accurately plotted. * * *

Journeys over the adjacent roads are made for the purpose of constructing itineraries, and of measuring and estimating distances by the eye alone, or by ordinary available means. Sketches will be made of the surrounding country, and directions of hill ranges, streams, etc., will be taken as the bases of reconnoissance maps. * * *

Problems relating to the more difficult constructions of masonry, such as groined, cloistered, askew and rampant arches, domes, and walls bounded by warped surfaces, etc., are solved in the engineering drafting room.

The principles and practice of framing, bridge and truss building, and of the construction of estimates and working plans, are investigated; and the solution of a problem in engineering, selected or approved by the Professor of Engineering, terminates the under graduate course, leading to the Degree of Bachelor of Science (B. S.

A practical bearing is given to the instruction of this year by the solution of interesting problems connected with the subjects taught; and by visits to important accessible structures, completed or in process of construction.

A post-graduate course of three years' length embracing the higher subjects of engineering study, leads to the degree of Civil Engineering (C. E.)

In the Schedule of Studies of Freshman year, drawing does not appear, the time being given to Geometry and Trigonometry. In Sophomore year 3 hours a week are given to

Industrial Drawing and Descriptive Geometry (3) — Practice in the use of instruments by means of construction of simple patterns and linear designs. Descriptive Geometry, and applications in construction of shades and shadows, perspective, etc.

In Junior year, students in the College of Mechanics, Mining and Engineers take 6 hours a week in—

Industrial Drawing (6)—Topographical, railroad, and mine mapping ; working drawings of simple machine parts; applications of graphostatics.

The students in Mechanics also take 5 hours a week in—

Graphostatics (5)—Applications in the determination of center of gravity, moments of inertia, and stresses on structures ; lectures and drawing-room work.

In Senior year, Students in Colleges of Mechanics and of Mining take 6 hours a week for first half year and students in College of Engineering 9 hours a week for the whole year in

Industrial Drawing.—Applications in strength of materials and Hydraulics, including designing of roofs, bridges, derricks, etc., water wheels, pumps, etc., and numerous important machine parts.

Also students in Mechanics take 5 hours a week through the week in "*Kinematics* and applications in the construction of machines (5)—Lectures, and drawing-room work."

The catalogue of 1881–'82, shows in the several courses a total attendance of 224 students, among these are included 38 partial course students.

From the latest Register of the University* at hand, the following Abstracts, which show something of the scope of the undergraduate courses, are taken. These include also the statistics of the teachers and students connected with the University in all its departments, and evidence its growth during the last decade.

ORGANIZATION OF INSTRUCTION.

GRADUATE COURSES.

To graduates of the University of California, or of other institutions of equal grade, who may wish to pursue advanced work, general or special, every facility is extended that the libraries, laboratories, and collections of the University afford. So far as possible, courses of study will be framed to meet the requirements of such students. These courses, with the approval of the proper authority, may be so chosen by the student as to lead to a Master's degree, to a Doctor's degree, or to a professional degree in some department of engineering.

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*Register of the University of California : 1. College of Letters :—(a) Classical Course. (b) Literary Course. (c) Course in Letters and Political Science. 2.—College of Agriculture. 3.—College of Mechanics. 4.—College of Mining. 5.—College of Civil Engineering. 6.—College of Chemistry. 7.—Lick Astronomical Department. 8.—College of Law. 9.—Medical Department. 10.—College of Dentistry. 11.—College of Pharmacy. 1890–'91. Berkeley. Published by the Regents of the University. 1891. Pp. 169.

UNDERGRADUATE COURSES.

Eight Regular Courses of study are at present established, leading directly under conditions hereinafter stated, to corresponding degrees, namely:

In charge of the Faculty of the College of Letters,—

I. *The Classical Course*, leading to the degree of A. B.;
II. *The Literary Course*, leading to the degree of B. L.;
III. *The Course in Letters and Political Science*, leading to the degree of Ph. B.

In charge, severally, of the respective Faculties of the five Colleges of Science,—

IV. The Course in Agriculture;
V. The Course in Mechanics;
VI. The Course in Mining;
VII. The Course in Civil Engineering;
VIII. The Course in Chemistry; each of which leads regularly to the degree of B. S.

To each of these Regular Courses there pertains an established curriculum of studies, prescribed and elective, arranged in the order of four successive years, as exhibited on subsequent pages of this Register.

There are permitted, in addition, *Courses at Large* and *Partial Courses*, not leading directly to any degree, but through each of which some one of the above-named degrees is possibly attainable."

The following shows how the prescribed course of drawing enters into the several college courses.

DRAWING.

I. ELEMENTS OF INDUSTRIAL DRAWING.—Geometrical drawing, brush-work, lettering. Three hours a week during the second term. Mr. Randall.

Prescribed, Freshman year, in the College of Civil Engineering.

II. INSTRUMENTAL DRAWING AND DESCRIPTIVE GEOMETRY.—Drawing of simple patterns, descriptive geometry, perspective, isometric projection, shade and shadows, etc. Three hours a week throughout the year. Mr. Kower.

Prescribed, Sophomore year, in the College of Mechanics, Mining, Civil Engineering and Agriculture, elective in the College of Chemistry.

III. TOPOGRAPHIC DRAWING AND MODELING.—Three hours a week throughout the year. Mr. Randall.

Prescribed, Junior year, in the College of Civil Engineering.

IV. MECHANICAL DRAWING.—Drawing of simple machine parts. Six hours a week throughout the year. Mr. Kower.

Prescribed, Junior year, in the College of Mechanics, and, in part, in the College of Mining.

V. GRAPHOSTATICS.—Graphical analysis of stresses in engineering structures. Two hours a week during the second term. Mr. Kower.

Prescribed, Junior year, in the College of Mechanics, Mining and Civil Engineering.

VI. CONSTRUCTION.—This Course includes the designing of engineering structures and machines. Six or nine hours a week throughout the year. Mr. Kower.

Prescribed, Senior year, in the College of Civil Engineering, nine hours a week; in the College of Mechanics, six hours a week; in the College of Mining, six hours a week during the first term. Elective, alternatively with Physical Laboratory, Course IX., or Metallurgical Laboratory, Course IV., in the College of Mining, during the second term of the Senior year."

The library of over forty thousand volumes is constantly increasing. The beginning of an Art Museum has been made, by gifts of a number of examples of Modern Art and of Classic Archaeology.

ART COLLECTIONS.

Fine Arts.—The Gallery of Fine Arts, in the Bacon Art and Library Building, contains ten paintings and three pieces of statuary, presented by Henry D. Bacon; fifty-five paintings, presented by the late F. L. A. Pioche; two landscapes by Klombek and Verboeckhoven, and five bronzes presented by Charles Mayne; the celebrated painting of Washington at Monmouth, by Leutze, presented by Mrs. Mark Hopkins; and about fourteen hundred photographs of statuary, the gift of John S. Hittell.

Descriptive catalogues of these collections (Library Bulletins Nos. 4 and 6) have been published.

Classical Archaeology.—The University has a cabinet of coins and medals, including over four hundred ancient coins, mostly Roman; about three hundred and fifty medals; and a like number of modern coins. There are also sets of wall maps of ancient countries, the gift of Charles Webb Howard, and many photographs and other pictures of ancient life, customs and architecture.

Various collections illustrating the sciences are contained in the Museums.

There are ten "Laboratories," of these the Mechanical Laboratory furnishes facilities for Industrial and Technical Training.

The Mechanical Laboratory is designed to offer facilities for tests and experimental inquiry, and comprises:

I. *A Machine Shop,* containing at present an engine lathe, built by Becker & Co.; a Prentice engine lathe, adapted for light machine work; a Stewart's brass-turning lathe; a planing machine, built by the San Francisco Tool Company; a Hendy shaping machine; an upright drill; a Brown & Sharpe universal milling machine; a power grindstone; an emery grinder and buff-wheel, etc.; a large supply of lathe tools, chucks, reamers, broaches, chasers, drills, instruments for precise measurement, dies, taps, etc.; and a complete stock of supplies necessary for making experimental apparatus.

II. *Carpentry and Pattern Shop.*—This room contains a band saw; a saw table, with circular saw for metal and wood; a wood lathe; a carpenter's bench, with an excellent assortment of carpentry tools; a planing and jointing machine, built by H. P. Gregory & Co., San Francisco; and a Frank's surfacing machine.

III. *Shop for Fine Work.*—This contains an improved Swiss gear-cutter, with complete set of cutters for cutting gears from the smallest pinion to a wheel of three inches diameter; watchmaker's lathes; a set of staking tools, a polishing hat of depthing tools, a small emery grinder; and a complete watchmaker's outfit.

IV. *Steam Fitting Apparatus.*—A complete set of steam-fitters tools, giving the student sufficient opportunity for practice in cutting and threading pipes, and making joints and connections.

V. *Foundry and Blacksmith Shop.*—This contains two crucible furnaces; a complete set of molder's tools for casting brass, etc.; a portable forge, built by Geo. Cumming & Sons, San Francisco; a 50-pound drop steam-hammer; an anvil, with set of blacksmithing tools; a small upright drill; an improved hydraulic blast, with soldering irons and burners, built in the shop; a pair of large shears, etc.

VI. *Engine Room.*—A four horse-power Otta gas engine, a fifteen horse-power Ohmen's automatic cut-off steam-engine, and a fifteen horse-power Babcock & Wilcox boiler.

VII. *Experimental Laboratory.*—This building, recently completed, contains five rooms. The main room is 30x40 feet, and is devoted exclusively to experimental purposes. It is provided with a nine horse-power Paragon engine, for exclusive laboratory use; a Richle vertical testing machine of 50,000 pounds capacity, and a

Richle wire-testing machine of 4,000 pounds capacity, both for tensile, compressive and transverse strains; a new dynamometer, for small power; two new registering instruments for speed; an apparatus for determining efficiency of jet wheels and partial turbines; an apparatus for the determination of resistance in water to rotating discs and cylinders, etc. These instruments were, for the most part, designed and made in the machine shop of the University, and are intended to form a complete collection for the course in experimental mechanics.

Tests of the strength of materials, tensile or compressive, on metals, wood or stone, will be made, free of charge, for any one who desires such tests. Printed circulars describing the proper form and conditions under which the materials to be tested should be sent, may be obtained by addressing the professor in charge.

* * * * * * *

LABORATORY PRACTICE.

The Mechanical Laboratory is designed to offer facilities for tests and experimental inquiry, such as (1) submitting to actual test, and verifying directly, principles developed in the lecture-room; (2) building and testing machines designed by the students; (3) investigating such subjects and engineering problems as are not only calculated to impart training in methods of investigation, but the results of which may prove of value to the engineering public at large; (4) ascertaining the character and proper treatment of materials, and acquiring familiarity with the appliances and processes necessary to the construction of designs.

If the student desires to acquire skill in the use of tools, opportunity is offered to him for practice, under the instruction of an able mechanician, (1) in the working of metal and the use of tools, to give him an insight into the most practical methods of manipulating given machines; (2) in wood turning, planing and carpenter work; (3) in molding and pattern making; (4) in steamfitting, such as cutting and threading pipes, etc.; (5) in forging and tempering tools.

After he has become sufficiently acquainted with the working of wood and metals, and is able to recognize the difference in machines, tools and methods of founding and blacksmithing, he is shown through manufacturing establishments, so selected as to enable him to see on a large scale those operations and methods with which he has become familiar only on a small one."

A total of 763 students are recorded as in attendance at the University, during the academic year, 1890–'91; of these, 450 are enrolled in the College of Letters and Colleges of Science. The remainder are in the Professional and Post graduate Departments.

Eleven students are in the College of Agriculture; 35 in the college of Mechanics; 30 in the college of Mining; 53 in the college of Civil Engineering. A total of 184 Officers and Instructors are connected with the Administration of, and the Instruction given in, the University. Of these, 60 are enrolled as Professors, Instructors, etc., in the undergraduate colleges of Letters and Science. The special Faculty of the College of Mechanics consists of 17 Professors and assistant Professors. Professor Martin Kellogg, A. M., the President *pro tempore* of the University, is, also, President of this College.

STATE AGRICULTURAL COLLEGE OF COLORADO.

The State Agricultural College of Colorado, situated at Fort Collins, founded in accordance with the law of Congress authorizing a land grant for such institutions, was formerly opened September 1st, 1879.—

Tuition is free—a matriculation fee of $5 is charged and an incidental fee of $1 each term. One dollar a term is charged for room rent, and board is fixed not to exceed $3 per week. There is a preparatory course of a year for those not qualified to enter at once upon the regular course of four years.

The studies taught are divided into five sections, viz:—Rhetoric and English Literature; Chemistry; Mathematics; Natural Science; Political, Moral and Intellectual Philosophy. Particular attention is given to Agricultural Chemistry and there is a farm of 240 acres, under careful, and chiefly experimental cultivation. Students are required to pass two hours each day working either in the shop or on the farm.

"Drawing, Krusi"; is given as an elective study during the Second term of Freshman year.—

"Mechanical Engineering" is taught the first term of Senior year.—

The catalogue for 1881, shows an attendance of 57 students, of whom 25 were girls.—

From the latest catalogue* at hand is taken the following statement of the courses in Mechanics and in Drawing.

PRACTICAL MECHANICS.

The old system of apprenticeship is rapidly becoming a thing of the past, and it is now almost impossible for a boy to learn a trade in any modern shop or factory. This is owing largely to the introduction of special machinery, necessitating special workmen to manage it, and the workman who has learned to run a machine of this kind is kept at that work, as being most profitable to his employer. His practical knowledge of other methods and machines is, therefore, confined to narrow limits, and should a vacancy occur in a superior position, he is not fitted for the place, from the fact of his being unacquainted with other practical parts connected with his trade, the manipulations and principles involved in which he has not had an opportunity to learn.

This department has for its object a systematic and progressive education in the use of tools and materials, combined with as much theoretical knowledge as shall be deemed necessary to explain the principles involved. It does not teach special trades, nor manufactures salable articles; to do so would require that the student be kept on the kind of work he could do best, and thus prevent him from acquiring broad and liberal ideas of other methods. So, without teaching any one complete trade, the mechanical principles of many are gained. This does not necessarily mean that the student becomes sufficiently expert to compete with the skilled mechanic, but that a knowledge of *how* a tool or machine should be used, and the manner of *laying out work* for the same is thoroughly taught.

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*Ninth Annual Register of the State Agricultural College, Fort Collins, Colo. 1887–'88. Pp 63

Should the circumstances be such that the student enter manufacturing, his ideas having been broadened by this training, he will the more readily grasp anything new that may come up in his business, or, if he take up farming, he will, with greater care, be able to understand the mechanical principles and workings of his machinery, and also how to keep it and his buildings in proper repair.

The shop instruction will be divided into courses, as follows, and in each course will be given, in connection with the work, an explanation of the construction of each tool, and its manner of acting on the material, the methods of determining how to select material best suited to different kinds of work, the manner of laying out work, cutting, speed of tools, etc.

COURSE OF LABOR.

First Year.

	Weeks.
Bench work in wood,	14
Machine work in wood,	4
Pattern making,	12
Vise work in iron,	10

Second Year.

Iron forging,	14
Steel forging,	4
Machine work in iron,	20

BENCH WORK IN WOOD.

This course consists of exercises with the different wood working bench tools, so arranged in a graded series as to embrace the manipulation of the tools in their various applications.

First. The use of planes in joining, smoothing and getting the piece out of wind, lining off, and the use of saws in cutting across and with the grain and keeping to line. Second—Halved splice. Third—Splayed splice. Fourth—Keyed splice. Fifth—Open dovetail mortise and tenon joint. Sixth—Mortise and tenon joint. Seventh—Open dovetail joint. Eighth—Blind dovetail joint. Ninth—Lap joint. Tenth—Dowel joint. Eleventh—Small newel post with hand worked rail. Twelfth—Panel door. Thirteenth—Roof truss. Fourteenth—Box. Fifteenth—Carpenter's trestle.

MACHINE WORK IN WOOD.

In connection with this course, with the use of tools, will be given the most rapid and economical method of selecting and preparing the wood for the machine. There will be given examples of First—Straight turning. Second—Cutting in and squaring off. Third—Convex, concave and compound curves. Fourth—Handles for chisels and other tools. Fifth—Examples in chuck work in separate and combined pieces. Sixth—How to turn a ball.

PATTERN MAKING AND FOUNDRY WORK.

After becoming familiar with bench and machine work in wood, an application of both is made, by constructing patterns with the regard to shrinkage, draft, and the best method of constructing the pattern, so that it causes the least amount of trouble in the foundry. There will be given examples of Plain work. Core work. Pully work. Pipe work. Gear work. Core boxes, their use and construction.

And in the foundry will be given practice in moulding in plain and core work.

VISE WORK IN IRON.

With this course will be given an explanation of the different kinds of tools and their effect on the material, and the style of tool to be selected for certain kinds of work. There will be given examples in Chipping cast iron, wrought iron and steel. Spline chipping. Hack sawing. Filing square and round surfaces to line. Shoulder, point and other free hand filing. Fitting joints. Finishing and scraping.

FORGING IN IRON AND STEEL.

Care of the fire. The effect of different heats on the material. Drawing, upsetting, bending. Scarf, fork, jump and other styles of welding. Welding iron to iron, iron to steel, steel to steel. Rings, chains, ring bolts, brackets, braces, heading tools, nails, bolts, hooks, hasps, swivels, tongs, cattle brands.

Steel wrenches, cold chisels, drills, lathe tools, springs, etc.

Examples in tempering and case hardening.

MACHINE WORK IN IRON.

Care of the machines, their construction, proportion and use of the different parts. Cutting speed of tools, and proper angle of cutting edge for different purposes and different metals. Centering and straightening work. Straight turning and squaring. Boring. Making and fitting joints. Chuck work. Screw cutting inside and outside. Drilling, tapping and reaming. Boring with boring bar and use of center rest. Polishing and finishing. Hand tool work.

DRAWING.

First Term.

Geometrical problem. Free hand copy and dictation. Designs. Linear perspective. Model and object drawing.

Second Year.

Orthographic and Isometric projections, and projection of shadows. Development and intersection of surface. Light and shade. Historical ornament. Wood carving, diaper, incised and relief. Persons having parts of machines, patterns, small models or working drawings, may, if they choose to donate the same to the department, confer a great favor upon the college, and especially upon the department.

Among the descriptions of the buildings, laboratories, conservatory and other facilities for instruction, there is the following statement of the building given to instruction and practice in "The Mechanical Course."

The mechanic shop, consisting of main building, 25x56 feet, two stories in hight, with a rear portion 20x62 feet, of one story. The upper floor of the main building is fitted with benches for sixteen students in wood work; desks and tools for ten students in wood carving, four wood lathes, a scroll saw and an iron frame buzz saw. The lower floor contains an iron working room, with sixteen benches for working in filing, etc.; a speed lathe, two iron lathes with attachments, a shaper, and two drills for wide range of work. There is also an office and a wash room, besides a wide hall containing the twelve horse power engine, and from which rise the stairs to the floor above. The rear portion contains boiler and coal room, forge shop with six forges furnished with blast from a fine Sturdevant rotary blower, and a foundry room. The machinery and appliances are first-class in every respect.

It appears that much attention is given to the Agricultural course, for which the farm of 240 acres, with its experimental ground of eight acres divided into twenty-five series of plats, offers excellent facilities.

The State law compels each student to perform two hours of labor daily, this labor is thus classified; the first, "that which is performed solely for the purpose of instruction;" the second, "that which is of some monetary value to the institution." The result of giving to practical or remunerative labor, the time, given in other colleges only to athletic or other sports, is stated as proving very satisfactory from every point of view.

Ladies Course.

The young ladies pursue the same course as the young men during the first three years. During the Junior and Senior years they may, if they choose, substitute the study of German for the designated special studies of the Agricultural course, or the Mechanical course.

The Faculty consists of 10 Professors, one Instructor and a Secretary. Two Ladies, one a Professor and one an Instructor, are members of the Faculty. Professor Charles L. Ingersoll, M. S., is the President of the College. The total attendance of students numbers 109, of these 71 are boys and 38 girls; there are 38 "Preparatory," 37 "Freshman," 18 "Sophomore," 2 "Juniors," 5 "Seniors," 7 "Specials," and 2 "Post Graduate," students.

Sheffield Scientific School—The Land Grant College of Connecticut.

The Sheffield Scientific School is a department of Yale University, New Haven, Connecticut. Thorough instruction is given in Chemistry, Civil Engineering, Dynamic Engineering, Agriculture, Natural History, Biology—preparatory to Medical Studies, and in studies preparatory to Mining and Metallurgy; also, in select studies preparatory to other higher studies. The regular course is of three years. There is also a course for Graduate students. The catalogue for 1881–'82 shows a total of 188 students, 19 of whom were Graduates and 5 special students.

Drawing.—The course in drawing extends through the three years. During the first term of Freshman year, the students practice free-hand drawing at the Art School building, under the direction of Professor Niemeyer, of the Yale School of the Fine Arts. After the completion of the course in free-hand drawing, instruction is given by Mr. F. R. Honey, during the second term, in the elementary principles of instrumental drawing, embracing Elementary projection drawing, Isometric drawing, and Descriptive Geometry as far as Warped Surfaces. This course is obligatory upon all.

During the Junior and Senior years, instruction in drawing is obligatory only on the students in Civil and Mechanical Engineering. In the former year the system of instruction embraces shades and shadows, tinting, perspective, and warped

surfaces. By this method all the problems in Descriptive Geometry are required to be worked out on the drawing-board instead of the black-board. The course extends through the entire year, and is under the direction of Mr. Honey.

In Senior year, students are required to apply the principles of drawing already obtained to works of construction, under the general supervision of the Professors of Civil and of Dynamic Engineering." * * *

In Civil Engineering the students, besides attending on Class recitations and lectures, pursue a systematic course of exercises in the different branches of Geometrical Drawing and Graphical statics and in the application of the principles of drawing to works of construction; and have good practice in the operations of Surveying and Field Engineering—acquiring facility in the use and adjustment of Surveying and Engineering Instruments. In Topographical Surveying they are instructed in the use of the Plane Table for topographical work, and are required to prepare a detailed chart of the ground surveyed—exhibiting the contour lines and all its topographical features. Numerous problems of computation, and graphical exercises, are included in the Course of Construction pursued in the Senior year. A course of Blow-pipe Analysis is also taken by the Senior Class, that a more thorough knowledge may be gained of minerals and building stones.

In Dynamic Engineering the method of instruction is by recitation and lectures, supplemented by work in the drawing room, by shop visits, and visits of inspection in and out of the city, and by tests with the indicator and dynamomter. The lectures are illustrated by models, by large cartoons adapted for the purpose and by the complete collection of working drawings of the Novelty Iron Works, owned by the School. In the drawing room, detailed working drawings of various machines are made. A general sketch of the proposed machine is given and complete detailed drawings are required, in proper shape for the pattern-maker or machinist. The student is taught the best practice, and his judgment is trained in choosing relative proportions. The student is required to describe the steps to be followed in building the machine, and to make as nearly as possible an estimate of its cost. Pattern, foundry, black-smithing and machine work are studied in detail. In the visits, machinery and processes are critically examined in detail, and sketches of important machines with written descriptions are required.

In addition to the above, a course of lectures is given every winter by the professors of the schools and others, on topics of popular interest."

The Biennial Report of the State Governing Board for 1889–'90.* begins as follows:

In presenting their regular Biennial Report the Governing Board of the Sheffield Scientific School can hardly fail to call attention in the first place to the rapid increase in the number of its students. This is the most noticeable fact in the history of the last three years. In the academic year, 1888–9, the total number in attendance was 305. In the following year it rose to 343. In the present year it has reached 381.

In one sense this is a most gratifying tribute to the success of the efforts made by the Governing Board to keep the institution in the front rank of those which are devoted to the furtherance of scientific education. Its students, as might be expected, come largely from Connecticut. But it also draws them from the most remote States and Territories, and draws them in constantly increasing numbers. This is as satisfactory evidence as can be given that the advantages furnished by the school are coming to be more and more widely appreciated in all parts of the country.

* Twenty-third Report of the Sheffield Scientific School of Yale University 1889–'90. Printed by order of the General Assembly. New Haven: Tuttle, Morehouse & Taylor, Printers: 1891. Pp. 86.

The Report quotes in full the law of Congress passed in 1890, giving additional funds to the Land Grant Colleges, a sum of $15,000 the first year, to be increased by adding 1,000 each year for ten years till a sum of $25,000 is given annually. A copy of this law will be given in one of the Appendices of this volume. The important addition to the facilities of the school by the acquisition of the former residence of Mr. Sheffield, now to be used for Laboratories, is recorded. Interesting analyses of the several states and countries from which the students were drawn in the Academic year of 1889–'90, and 1890–'91, are given.

Of the 343 students in 1889–'90, 120 were from Connecticut, 69 from New York, 27 from Illinois, 24 from Pennsylvania, 17 from Ohio, 9 from Massachusetts, 8 from New Jersey, 7 from California, 5 from Colorado, 5 from Rhode Island, 4 each from Minnesota and Missouri, 3 each from Kentucky and Maine. In all, 26 States and 2 Territories were represented. There were also 7 students distributed between five foreign countries. Of the 381 students in 1890–'91, 118 were from Connecticut, 75 from New York, 30 from Illinois, 26 from Pennsylvania, 21 from Ohio, 12 from Massachusetts, 11 from California, 7 from Indiana, 6 from Colorado. In all, 28 States and 3 Territories, were represented; while the five countries of Canada, England, Japan, The Sandwich Islands and Turkey, sent one student each; Canada and The Sandwich Islands, however, had each two. Certainly "Sheffield" can hardly be classed as a "provincial" Institution.

The catalogue which follows the Report, gives this concise history of the school:

HISTORY AND ORGANIZATION.

The school was commenced in 1847. In 1860, a convenient building and considerable endowment were given by Joseph E. Sheffield, Esq., of New Haven, whose name at the repeated request of the Corporation of Yale College, was afterwards attached to the foundation. Mr. Sheffield afterwards frequently and munificently increased his original gifts.

In 1863, by an act of the Connecticut Legislature, the national grant for the promotion of scientific education (under the congressional enactment of July, 1862), was given to this department of Yale University. Since that time, and especially since the autumn of 1868, numerous liberal gifts have been received from the citizens of New Haven, and from other gentlemen in Connecticut and New York, for the endowment of the School, and the increase of its collections.

The action of the State led to the designation by law of a State Board of Visitors, consisting of the Governor, Lieutenant-Governor, three Senior Senators, and the Secretary of the State Board of Education; and this Board, with the Secretary of the Scientific School, is also the Board for appointment of students to hold the State scholarships.

The Governing Board consists of the President of Yale University, the Director of the school, and the professors who are permanently attached to it. There are several other instructors associated with them, a number of whom are connected with other departments of the University.

The courses offered are numerous and the facilities in the way of collections and books are ample. Instruction in the courses related to those here considered is given as follows:

Drawing and Descriptive Geometry.—Drawing is begun at once in the first term of the Freshman year, under the charge of the Professor of Drawing in the Art School, and includes practice in free hand drawing. In the second term, under the Instructor in Instrumental Drawing, the students take isometric drawing with application to drawing from models and structures by measurement, shading, tinting, conventional use of colors, principles of orthographic projections, and practice in making simple working drawings, 4 hours both terms.

The Drawing of Junior year, 3 hours both terms, includes Descriptive Geometry, the drawing of structures from measurement, and elements of design for simple structures. The instruction is by recitations, lectures, practical exercises and models, and is under the charge of the Instructor of Instrumental Drawing and the Professor and Instructor of Civil Engineering. Included in the work of this year is also the mapping of surveying field notes.

In the Senior year, the drawing consists of the mapping of the surveys of that year, and the designing of structures and finished drawings, designs and estimates, under the charge of the Professor and Instructor of Civil Engineering, 6 hours both terms.

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Mechanical Engineering.—The objects aimed at in the plan of instruction in this course are, to give to the student a thorough training in elementary and advanced Mathematics and Physics, and their application to the Science of Construction; to make him familiar with the general principles of Engineering and with the practical details of mechanical construction through which these principles are made useful; and to enable him ultimately in beginning the work of his profession to bring to bear upon it a well balanced store of theoretical and practical knowledge, and a mind trained in correct habits of thought and work.

The complete course covers five years, three of which are spent in undergraduate study, and two in a graduate course, a portion of which may be spent in actual practical work.

Under this course of "Mechanical Engineering," instruction is given in "Mathematics," "French and German," "Surveying," "Shop Visiting," "Drawing," "Principles of Mechanism," "Steam Engine," "Indicator Practice," "Applied Mechanics," "Thermodynamics" and "Machine Design." An accepted thesis on some topic approved by the Professor of this department must be presented by the student before graduating.

Of these studies, the programmes of the following which relate to our topics, are quoted:

Shop Visiting, divides the time equally with Drawing in the Junior year until the spring recess. The student, accompanied by the instructor, is employed in studying machinery in use and in process of construction in different machine shops in the city. He is required to make satisfactory, careful dimensioned sketches from measurements taken by himself, of the complete machines and their parts, and to describe the tools and mechanical operations used in producing the simpler pieces.

Drawing.—Descriptive Geometery is taught in the drawing room by lectures and recitations and by exercise at the drawing board, where the problems are solved graphically by the students. Instruction in drawing Machine Elements is given in

the Junior year. Models and cartoons showing examples of approved practice are used by the instructor, who also gives personal attention to each student's work at the board as it progresses.

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"*Machine Design.*—The course in this subject consists chiefly in practical exercises at the drawing board, and partly in lectures on the functions of machines and the mechanical principles which are applied in determining the proportions of machinery. The student, under the guidance of an experienced instructor, is employed in making complete working drawings of machines, many examples of which are in the drawing rooms and the basements of the school. He does not copy the examples, but is required to change the dimensions and in many cases to alter the design, and is ultimately taught to make partly new designs of important machinery, such as cranes, yacht engines, machine tools, boilers, etc. The discipline the student receives is such as he would obtain in the drawing office of an engineering establishment, while he is also carefully instructed in the theory of the subjects he deals with, and in the practical bearing of all his work.

In the Senior year, several excursions are made by the class, accompanied by one or more instructors, to neighboring manufacturing and engineering centers where large manufactories, pumping works, ocean steamers, etc., are visited. Full notes must be taken, and a satisfactory written report upon the machinery examined is required of the student.

Thesis.—Before graduating, the student must present a satisfactory thesis on some subject approved by the professor in charge of the department of Mechanical Engineering.

A course of lectures on the theory of Electricity and its applications is open to students in this department, and these lectures can be taken as a part of the preparation for a graduate course in the higher branches of electrical science.

President Dwight, as the head of the Yale University is President, and Professor George J. Brush, Director, of the School. The Governing Board numbers 15 full Professors, 25 additional Professors and Instructors, complete the teaching force of the school. The 381 students, are distributed in classes as follows:

SUMMARY.

Graduates	30
Seniors	90
Juniors	118
Freshman	137
Special Students	6
	381

Delaware College, Newark, Delaware.

When some years since, the accounts of the several Agricultural Colleges were prepared for this Report it was stated that there were in this college, three courses of four years each, the classical, scientific, and agricultural, but that the study of drawing is not given as a required study in any of the courses. As it is only by reason of the teaching of this study and that of Manual Training, that any notice of these colleges is given in this particular Report; this college was thus briefly chronicled.

The catalogue for 1892,* however, shows very different conditions.

Delaware College, the college which was designated by the State to receive the benefits of the Land Grant Act of 1862, and has since been made one of the Government Agricultural Experiment Stations under the "Hatch Act," is situated in Newark, a town in the northwestern part of the State of Delaware, near the boundaries of Pennsylvania and Maryland, at the head of the peninsula formed by the Chesapeake and Delaware Bays. The great northern and southern railroads pass through it, and it has railroad communications with all parts of Delaware, and with the Eastern Shore of "Maryland and Virginia."

Notable additions in the way of buildings, apparatus, and books, have been made to the college during the past two years. A shop 30x50 feet has been built and equipped for wood-working and a building for iron working is promised.

Seven courses of study are offered. These are the classical: Latin Scientific; Modern Languages and Sciences; Mechanical,—Civil and Electrical Engineering; and Agriculture. Each is of "four years in length and all are equal to similar courses in other high-grade colleges."

The study of drawing is now made a requisite in some part of all the courses. In the three Engineering courses it is required throughout the whole course.

There is a thorough course in Civil Engineering. The following is the official statement of the courses in Mechanical and Electrical Engineering.

11. MECHANICAL AND ELECTRICAL ENGINEERING.

Prof. Weihe.

These courses extend over a period of four years. The studies during the first three years the same in both.

Students who have completed either of these courses will be expected to be sufficiently prepared to do such work as is generally given to young engineers. It is intended to turn out useful young men who have a fairly good knowledge of the principal features of the work done in their profession.

To obtain such a knowledge the fundamental principles of the different subjects are taught first and these are then applied to practical problems. The manufacturing establishments in Wilmington and neighboring cities will be frequently visited, and the student will then be required to give accounts and descriptions of the different processes he has seen. In "Journal Meetings," to be held weekly, articles appearing in the leading engineering papers will be discussed.

The technical education of the student begins in the Freshman year with drawing. He is first taught the different kinds of lettering. Good lettering adds not only to the appearance of drawing, but also to its clearness.

Isometric and instrumental drawing are taken up next. In the latter course the student is made familiar with the use of the various drawing instruments. A large number of graduated exercises will be given which involves such geometrical constructions as are mostly used in machine drawing.

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* Catalogue of Delaware College, Newark, Delaware. 1892. Pp. 40.

During the last term perspective and projection drawing are substituted for isometric, while the mechanical is continued. The student is now required to make free-hand sketches of various machine parts, and these will be used to make complete working drawings.

During the whole Sophomore year two exercises a week are devoted to the design of the elements of machines. Among them may be named bolts, nuts, gear-wheels, pulleys, journals, bearing, etc.

The drawing in the first term of the Junior year consists of making diagrams and designs of valves and valve gears. In the second term the design of a modern high-speed engine is begun and is continued during the remainder of this and the whole Senior year.

An elementary course in steam engine is given during the last two terms of the Freshman year. It is intended to make the student familiar with the different parts of a steam engine and with the fundamental properties of heat and steam. This is followed by a course in steam boilers in the first term of the Sophomore year. Elementary theoretical mechanics are taught during the last two terms of this year. This prepares the student to take up the more advanced studies in kinematics, mechanics of materials, and hydraulics in the Junior year.

Instruction in shop work is given twice a week throughout the whole course. Work in wood is taken up first and includes turning, bench-work, and pattern making. Then follows work in iron, as planing, turning, drilling, and milling. Short courses in mill-wrighting, boiler-making, and molding are also given.

Whenever practicable, the student will be given such work as he himself has designed in class.

As soon as the student is sufficiently prepared tests of different nature are made. Among these are tests of boilers, engines, pumps, dynamos, lubricants, of the quality of steam, and the strength of building materials.

A thorough course in practical physics is given during the Junior year. Special attention will be paid to the calibrating and standardizing of measuring instruments. Such experiments will be performed as will give the student the right idea of the relations between work, force, space, matter and time.

The total number of students in 1891–'92 was 97. Freshman 41, Sophomore 21, Junior 23, Senior 10, Post Graduate 2.

The Faculty consists of twelve Professors, Albert N. Raub, A. M., Ph. D. President.

THE STATE AGRICULTURAL COLLEGE OF FLORIDA.

This is one of the most recently established of the Land Grant Colleges. From the latest catalogue* it appears that its organization comprises four "courses" The "Agricultural, Degree B. S." Scientific and Classical, Degree A. B." "Mechanical, Degree M. E."; "Civil Engineering, Degree C. E."

The military organization seems to be made very prominent, all students of the college proper are required "to wear the uniform and all not physically disqualified to perform military duty." The Commandant, an officer of the U. S. Army, ranks next to the President of the College. There is a preparatory department with a two years course attached to the Institution.

* 1891–'92. Catalogue of the State Agricultural College of Florida. Published by The Board of Trustees, Lake City, Florida. Pp. 41.

Drawing, is a required study during Freshman year in the Agricultural course; through the four years in the Mechanical course; and for three years of the Civil Engineering course.

The following official, historical and general statements are from the catalogue.

"GENERAL INFORMATION.

ORGANIZATION.

The Florida State Agricultural College, which receives its support mainly from the fund provided through the Congressional act of 1862, was established at Lake City in 1884. "To provide for a liberal and practical education in the several pursuits of life," the Board of Trustees founded this institution, organized to meet the special needs of the State, whose organic law requires "to be taught such branches of learning pertaining to agriculture, the mechanic arts, military science and tactics, and such other scientific and classical studies necessary to promote the liberal and practical education of the industrial classes in the various pursuits and professions of life;" a school in which liberal culture and practical education shall proceed together, in which the Arts and Sciences shall be thoroughly taught and diligently studied in their theoretical as well as applied forms.

FACILITIES.

The Board of Trustees have always endeavored to sustain a liberal policy, striving to afford the best instruction and full equipment for theoretical and applied work at the least possible cost to the students. The limited and restricted endowments from the State and small interest income from the land grant fund, were inadequate to properly sustain all that was undertaken. However, a State College, like a well established farm or business, should have some pioneer experience in order to become safely established on a permanent basis, all of which has been accomplished.

It is fortunate to the college and the State that just as the critical formative stage is passed, the General Government, under whose fostering care the agricultural and mechanical colleges were established and mainly sustained, comes to our assistance with the endowment provided by the Morrill Bill which passed the Congress and became a law last August. Under this act each state received an amount annually, beginning with $15,000 for the year ending June 30, 1890, and increasing by $1,000 a year for ten years, when the endowment shall remain permanently at $25,000 per annum.

Where a distinction is made in regard to race or color, it is required to equitably divide this fund between the college for white students and a similar school for colored students. Of the two installments thus far received ($31,000), the Colored Normal School at Tallahassee, under Governor Fleming's division, has received one-half. The division hereafter will be based upon the school population as shown by the last report of the State Superintendent of Public Instruction. By this apportionment our college will receive 53.4 per cent. of the annual endowment.

This fund is restricted to "instruction in agriculture and the mechanic arts, English language and the various branches of mathematical, physical, natural and economic sciences with especial reference to their application in the industries of life, and to the facilities to such instruction." The bill prohibits using this money building, buying, renting or repairing buildings, and implies that no land shall be rented or purchased with it.

This college will thus derive from all sources of income a sum equal to about $16,000 per annum, which is less than half what the State colleges of Mississippi,

Alabama, South Carolina and several other Southern States receive and about one-sixth the annual endowment of similar colleges in the North. The State of Florida has given less to support its agricultural college than any other State or Territory.

Several additional professors and assistants have been employed, the agricultural department fully equipped, so that now farming operations are carried on by the students taking the agricultural course, under the direction and instruction of the Professor of Agriculture, independent of the Experiment Station. There has been purchased a full outfit of machinery and tools for the four years' course in manual training; apparatus for the chemical and physical laboratory, and also for botany, astronomy, physiology, and civil engineering; cabinets for teaching mineralogy, geology, zoology, entomology, etc. About $2,000 worth of new books have been added to the library. These and many other improvements have been made which, it is hoped, will start the college on an era of unhindered prosperity and merit the patronage of all classes.

LOCATION.

Lake City, the seat of the college, a town of about two thousand inhabitants, and the county seat of Columbia county, is situated at the junction of the Florida Central and Peninsular, the Savannah, Florida and Western, and the Georgia Southern and Florida railroads, fifty-nine miles west of Jacksonville. It was selected by the Board of Trustees, among other reasons, on account of its well-known healthfulness and accessibility.

Numerous beautiful live oaks and water oaks of gigantic proportions shade the streets and dwellings, and charming lakes of pure water, with clear margins, may be seen in and around the town, offering to the student in his hours of relaxation abundant opportunity for aquatic sports. The climate during the months of the scholastic year is unsurpassed for its equable mildness and cannot fail to charm and benefit delicate students from Northern latitudes. They will pursue their studies in a pure atmosphere, rarely chilled below thirty-two degrees in the midst of winter. Churches of all the Christian denominations offer free sittings to students."

The topic of Manual Training is thus treated.

MANUAL TRAINING.

H. C. Powers, Professor.

In pursuance of the law passed by Congress creating the Agricultural and Mechanical colleges and the stronger law of public opinion, the Department of Manual Training in this college will be made as complete and perfect as possible.

We realize that a large percentage of our pupils will become practical farmers or manufacturers in their coming manhood, and in order to best fit them for such a life a training in the practical use of the different tools and implements used in the various trades is greatly needed.

A practical education means much more to-day than it did thirty years ago. Not only must the brain be taught from books but the hand as well must be trained to act and the eye to see, thus making a complete and symmetrical education of the whole boy.

There can be no question that the boy so trained will start in life with much greater possibility and probability of success than the one with only a classical education.

Every man, whatever his calling or profession has more chances of success in

life with all his powers fully trained than one whose education is incomplete and onesided.

The education from books alone neglects some of the powers of all pupils and all the power of others.

We do not profess to teach any particular trade, but the fundamental principles of all trades, nor do we make any articles for sale. All work is disciplinary and instructive, and as soon as a pupil fully understands one step he is advanced to the next.

Our course of Manual Training covers the entire four years and must be taken as laid out by the Faculty of the College. No pupil will be allowed to take any part of the course until he has been over all that precedes it.

Drawing is considered as a part of the course of Manual Training, and pupils who take the shop course will be required to take the drawing course as well.

The first year of shop work is entirely taken up with instruction in wood work and the tools used therefor. The first two terms are devoted to bench work and the last term to wood turning. The shop for this work is fully equipped with tools and machinery for this course for a class of forty pupils. The bench work consists of instruction in the care and use of all ordinary carpenter and pattern maker's tools, and the performing of such operations as planing, sawing, mortising, tenouing, dove-tailing, squaring, tongueing, dowelling, etc. A full course will be given in wood-turning and scroll-sawing. A fine set of wood working machinery, such as a circular sawing machine, scroll saw, plainer, large and small wood lathes, is driven by a ten horse power engine.

The second year's course will consist of instruction in pattern making, moulding, and casting, brazing, sheet metal work and soldering, This shop is now ready for the class who have just finished the first year's work in wood.

The third year's course will consist entirely of instruction in forging iron and steel and in tempering steel tools. At the beginning of the year the class will be taught how to use hammer and anvil by working in lead, which metal acts similar to hot iron under the hammer. Then the fires will be lighted and exercises in drawing, upsetting, bending, punching and welding will be given in both iron and steel. Each student will forge and temper the tools that he is to use in the succeeding year in the machine shop. The properties of iron and steel will be thoroughly taught by lectures.

The fourth year's course will be given to machine shop instruction, and will consist of exercises in chipping and filing at the bench, boring, turning, planing, shaping and drilling on machine tools. During this year instruction will be given in the management and care of steam boilers and engines. Students taking the entire course will be permitted to make some "project," which shall combine the experience of the entire four year's course in shop and drawing room instruction.

Each exercise in the shop will be made from drawings made by the pupil in a book kept for that purpose. This will be required in every case.

In the four years' course of drawing, instruction will be given in the making of shop drawings, mechanical drawings, use and care of instruments, orthographic projections, isometric projections, lettering, plans and elevations of architectural work, tracings and blue printing.

The instruments used in this course will cost not to exceed $8. These the student must furnish. All shop tools and materials are furnished by the school.

Drawings will be returned to the pupils at the end of each year, except such as the school shall wish to retain for exhibition.

The time given to Manual Training during the past year has been one hour for shop work and forty minutes for drawing each day of the school week, and will not be less in the coming year.

CONDITIONS OF ADMISSION.

Only students qualified to enter the Freshman class in either the Agricultural or Scientific courses will be permitted to take Manual Training, and all entering these two courses must take the course in Manual Training and Drawing.

Each cadet in this department pays an annual fee of two dollars for materials used.

The catalogue quotes a list of 107 under graduate students in attendance. The list fails to indicate any students as in the Preparatory Department.

There are nine members of the Faculty. F. L. Kern, A. M., is President.

Georgia State College.

The Georgia State College of Agriculture and Mechanic Arts, of the University of Georgia, is situated at Athens, Georgia. The University has, besides the "State College," an Academic Department known as "Franklin College," both in Athens; and, also, a "Law", and a "Medical", Department, the latter situated at Augusta. It in addition comprises four branch Agricultural colleges; respectively situated at Dahlonega, Thomasville, Cuthbert, and Milledgeville. From these branch colleges, graduate students are admitted to the junior class of the University;—taking there the final two years of their course and their degree.

The State College comprises the three schools of Agriculture, Engineering and Applied Chemistry. The courses for the first two years are the same. In the Freshman year, "Linear Drawing" is a required study and in the Sophomore class "Geometrical Drawing." In the Junior Class, in the course for degree of Bachelor of Agriculture, "Surveying and Drawing" are grouped together; and in the Senior class, "Rural Engineering and "Building Construction."

In the course for degree of Bachelor of Engineering, in the Junior Class, "Geometrical Drawing, Pen Drawing, Tinting, Lettering, etc.; Topographical Drawing, Descriptive Geometry and applications; Shades and Shadows, Isometrical Drawing and Perspective," are required studies; and in the Senior year, "Engineering Drawing." There is a special course for the degree of Civil Engineer, requiring at least an additional year as well as passing a satisfactory examination. In this course "Warren's Machine construction and Draughting" is one of the required studies.

There is also a "Course in Building and Architecture."

COURSE IN BUILDING AND ARCHITECTURE.

"This is a partial course in the Department of Engineering, and includes the studies of the first, second and third year in Engineering, omitting a part of the higher Mathematics, and instead thereof giving attention to Architectural Drawing, Structures of Wood, Stone and Iron, Foundations, Walls, Arches, Trusses, Roofs,

etc.; the application of Descriptive Geometry to Masonry and Carpentry; Strength of Materials; Ventilation, Warming, Acoustics; Building Materials—Woods, Stones, Mortars, Cements, Paints, etc.

Upon the satisfactory completion of this course, a certificate will be given, stating the time spent at the College, and the progress made." * * * * .

DRAWING.

"Two halls, 34 feet square, well lighted, now used oy students in drawing. Each student of the State College is employed in drawing during a part of the course, from one to two hours each day. During the first year, all are required to take Linear Drawing, being applications of Practical Geometry as an auxiliary to the study of Geometry. The full course includes Orthographic and Isometrical Projections, Development of Surfaces, Practical Perspective, Linear, Building and Architectural Drawing, Masonry Drawing, Drawing for Carpenters, Mechanical Drawing, including drawing from rough sketches; Drawing and Shading from solid objects; Drawing of Machinery."

The catalogue of 1882 gives 42 students of Drawing out of a total of 146 students. The "Annual Announcement" for 1886–'87, shows an attendance in The Franklin and The State College together, of 195 students; of these, 56 take drawing. The faculties of the two colleges are composed of the same Professors, with a single exception of one additional Professor in Franklin College. Ten Professors make the faculty of Franklin. P. A. Will, DD, LLD. is at the head of both colleges.

The Autumn of 1888, saw the opening of a new department of the University of Georgia in the inauguration of The School of Technology, October 5th, 1888, in Atlanta.

This event was recognized as marking the beginning of a new era in education; and the occasion of the formal transfer of the new institution to the Trustees of the State University, was made memorable by the ceremonies of a great public meeting held in the Opera House in the evening. The actual opening had taken place during the inspection of the school by the Trustees in the morning, when, in the presence of the State Trustees, the Governor, two Ex-Governors of the State, and many distinguished citizens, Miss Nellie Inman, daughter of one of the State Commissioners, was escorted by Ex-Governor McDaniel, to the engine; and, at noon exactly, turned the valve which started the engine and set all the machinery in motion!

This engine was made by the last year's class of the Worcester Technological Institute. The Superintendent of the machine shop, Milton P. Higgins, formerly of the school in Worcester, Massachusetts, then addressed the company who were about to inspect the several shops, and briefly outlined as follows the course of training to be given in this new School of Technology.

"LADIES AND GENTLEMEN:—I am desirous of stating to you, before you inspect the shops and equipments, some facts about them, and to indicate the methods proposed for utilizing these liberal facilities to the best good of the student. This can be done better here before we enter the shops where the machinery is in motion.

No occasion can possibly be of greater interest to me than the opening of a technological school of this character.

A kind Providence has made it my duty for twenty years to labor in this special field. Twenty years ago there was no precedent in America for technological education, and European methods were not in their nature fully adapted to the American boy.

The method here will be simple and direct. We aim to place the student during his course of training here in an environment not unlike what he may expect to find when he enters the active duties of life.

First of all we recognize the shop as a means of education, training, even culture. This is the highest object of the shops in any school of this character. The friends of this school do not ignore the intrinsic value of the skill attained in the shops, but as valuable as this is, the greatest value of shop training to the man and to the engineer is the marked effective influence upon the mind and character of the pupil. It has been shown that most of the active, managing men of a city are men whose boyhood has been spent on country farms. Now, there is no virtue necessarily in farm work or country life, except that the individual is brought into close contact with things. They meet and overcome many difficulties, and this experience develops sound judgment and ability to manage affairs in a most remarkable manner. This developing influence upon the character is exactly what the shops of a technological school accomplish.

It follows then—if difficulties overcome, educate and develop—we must have a real shop, where real difficulties are overcome. and where real successes are achieved. A play shop can not do it. A productive shop is a complicated affair. It is a new condition in a school and demands special methods. The shop and its methods must be real, alive, effective. All the men in the shops must be working men, devoting all business hours of the week to productive work, the same as in other shops. They are all there as teachers of what they know but their teaching is largely by example with such explanations as may naturally go with their work. All the shopmen may understand that the object of the shop is educational, but, in order that sound business may be taught and illustrated, every effort must tend to economical production.

The plan of operating the shops is as follows:

The Georgia school shops recognize that their object is educational, first and last. This is not a trade school. It is more. It aims to make mechanical engineers, manufacturers, managers of industrial works of all kinds. It will teach a trade, *i. e.*, it will develop manual dexterity because that is a most desirable and necessary step up to the end sought. It may produce journeymen, if you please, not as the end of the training, but the education of the engineer should include, to some extent, the experience that the journeyman possesses, the accuracy of the machinist, the skill of the pattern-maker and the special knowledge of the blacksmith and foundryman. And we believe there is no way so sure, so good, and so simple to realize these possessions as to enter the ranks and learn them as if future success depended upon the narrow knowledge of these trades alone.

We, therefore, aim to have the education of the student lead up through these steps so that if a boy starts with a class of a hundred to master all that would make him a successful engineer or manager of larger industrial interests, and he fails to attain his full object, that whatever be the cause of his failing of high leadership, his education at this school shall not be by any means a failure. Dexterity in any art or trade is a step to something higher. Whoever stops at one step has the dexterity that is as valuable to him and more so than if he had started in life to learn the trade only. There are many things to prevent all in a class of a hundred from being eminent leaders in mechanical pursuits. Of course, there is always room at the top, and, thank God, there is room all the way up for the man who knows well what he knows and can do it well.

In starting a class of young men in the Worcester shops it is my practice to show them first that they must very soon find within themselves a love and respect for their calling. They are taught at once that nothing is more promising of reward and honor and success than the pursuit of science, of mechanics, and the industries; and the school of technology is not a rival or a substitute for the college; that professional men, or statesmen, professors, lawyers, doctors, and ministers have all been held in honor justly, because of their training, because of their characters and because of their culture, and thus they have made their professions honorable. Now, the time is at hand when a mechanical engineer, a manufacturer, has every need and every inducement and every facility for obtaining all that makes any man worthy of the esteem of his fellows, viz: education in its truest sense.

We teach them at Worcester not to be disappointed or discouraged if at first there is a failure to find much love in the chosen work, but such a love can and must be developed. A loving, devoted dwelling upon the beauties of mechanical science is as possible and necessary to the successful mechanic or engineer as devotion is in any profession. They are taught at once that there is no conflict between practice and theory; none at all. Education is as desirable and possible in one pursuit as another, though it may be of a very different sort.

At Worcester we receive into the shop each year about thirty pupils, at an average age of eighteen to nineteen years. They remain three and a half years. After the first month they are in the shop only two half days per week, *i. e.*, ten hours per week during term time.

After about two months they are put at productive work, and sometimes much sooner. We are ever holding more strongly to the method of productive work as a means of education. At the end of the course of three and a half years our graduates have enough practical shop instruction to compete with young men who have devoted three years entirely to the learning of a trade, and in addition they have the advantages of their scholastic education.

The evening exercises at the Opera House were largely attended. They were opened by prayer by Rev. Dr. Tucker. Dr. Hopkins, the President of the school, in the course of his opening remarks before introducing the speaker of the evening, said:

Under the circumstances it would be improper for me to occupy your time in making a speech, but this is a time for congratulation, and I would congratulate those that have done this work, and spared no effort to do it well. I would congratulate the public-spirited men and women of Atlanta, who have encouraged the work. I would congratulate the trustees of the University of Georgia, for in all its history there has been added to it no such efficient arm of service than this. A new prestige has been given to the educational system of the State. The state at large is to be congratulated that here, in its capital city, is established this potency for good. The establishment of any school is an important event, inevitably affecting the weal and woe of the community about it. More important than others is the school established for a specific purpose, and the establishment of this school, at this time, in this place, is of special importance. This system of education is the result of enlightened discussion between the friends of classical education on the one hand and of practical education on the other.

Dr. Hopkins introduced Hon. N. E. Harris, of the State Commission, who made the Report of the Commission and presented the school to the Trustees of the State University.

Col. Harris began as follows:

Mr. President, Gentlemen of the Board of Trustees, Ladies and Gentlemen: It is said we live in an eminently progressive as well as practical age. There is a con-

stant demand for new methods in every department of life. The solution of the great problem of individual destiny is being wrought out under new and different processes every day. This has necessitated new methods of study and thought. The watchword now is "advance." Even education has moved onward with the times. No one of the old school would recognize the modern means and instrumentalities for educating the young. For a long period the conservatism of the college stood in the way of reform. But the American people have a way of solving problems that is shorter than that practiced by our ancestors. Things which are going into "desuetude," to use Mr. Cleveland's word, are either changed to suit the times or incontinently kicked aside.

The great middle classes of the country have begun to demand attention—more than at any previous time in the world's history. Men's eyes and noses are worth more to-day than they were a century ago. We approach the days of perfect equality. The lower classes have risen upward and higher classes have moved downward. Legislation for the masses is now legislation for the greatest good to the greatest number. Knowledge must be adapted to their wants. They do not boast the blue blood of the cavalier—they use their hands in making a living. It is no disgrace now. But Americans control the colleges of this continent, therefore as these institutions could not prevent, they have at length decided to lead these reforms. The curriculums are being remodeled all over the country, and no state in the union now making pretensions to higher education can be found without its technical school, either in process of erection or already open.

Georgia began the agitation years ago. The thought took shape in universal demand by the press in 1882, headed by the Macon Telegraph. In 1883, the first bill was presented to the legislature. In 1885, the present law was enacted, under which the institution in whose honor we are gathered, was established.

Knowledge and reform travel slowly in the face of prejudice. Some difficulty was experienced in prevailing upon the representatives of the people to grant to the state the right to get in line with the progress of the country. It is easier to defeat a bill than to pass one, under the peculiar provisions of our constitution. Every absentee counts for a negative vote.

Let us give credit to whom credit is due. The ten young representatives of the people who took their singular and striking journey to the north for the purpose of studying the question of technical education, in the spring and summer of 1883, had no conception of the magnitude of the problem which they had undertaken to solve. After the real character of the undertaking was revealed to them, it took some courage to present their views to the body they represented, and through that to the state, recommending the establishment of this institution—for the obtainment of money for education at that particular time was exceedingly doubtful and difficult to say the least.

He then paid a brief tribute to each of the ten members of the committee. They did not succeed in securing the desired legislation at that session and the efforts were resumed at the next. The new supporters of the bill were, each in turn, named and eulogized by the speaker.

The bill was finally enacted into a law and the next question to be settled was one of location. Georgia was poor. She had the capitol upon her hands into which she was pouring annually nearly $30,000. Therefore, she thought it not beneath her dignity to ask help of the flourishing towns and cities of her territory, and the school was directed to be located at that point which would furnish the best inducements in money or otherwise to the state. So the great municipalities began the contest for the location. Macon, Athens, Penfield, Milledgeville and Atlanta

entered the list in generous rivalry, but Atlanta, strong shouldered and steady hearted in her faith for the future, poured $70,000 into the state's coffers and threw in a site and $2,500 a year for twenty years additional, thus securing the location over all her rivals. Yon magnificent building, yon splendidly equipped machine shop, honorable alike to the city and the state, is the result, and we are here to-night to turn over the splendid property to its rightful custodions.

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As the chairman of the state board of commissioners, I am here to announce the completion of the labors entailed upon us by our appointment under the present law. The college is now already opened, its corps of instructors have been chosen, able, experienced and well fitted for the positions to which they have been called.

The prospects are flattering. Two hundred young men, if we are not deceived, will join the classes of the institution to be taught therein naught but the gospel of labor.

The great heart of Georgia will soon be here. The eyes of the state will be upon the institution. The experiment is new and untried, and upon the event hangs a fearful arbitrament.

The school is a part of the state university. There can be no rivalry between the two. The head is in Athens; the hands are here. Without this school the university would be incomplete; with it the demand of the times is met and the university is abreast of the age. Here we have thought versus work. Practice against theory. The shop against the study; the hammer against the book; the blouse against the cutaway.

The old statesmen who conceived the idea of the state university had in view the founding of an institution which should extend to every county of the state. It was intended to become merely an aggregation of schools. The ultimate limit of expansion was to be reached only when there should be a college established in every county of the state. Under the state constitution, the university is still the head of all state academic education, and no appropriation can be made to this object except through its board of trustees. As these colleges, therefore, are multiplied, it approaches nearer the ideal intended by its founders. In Augusta is its medical branch, in Athens the literary branch, in Dalonegha an adjunct of the literary branch, in Atlanta the technical branch, in other places feeders of the literary branch. If the money availed there ought to be no objection to this.

Will the state support this institution? That is the question which the future must settle. It belongs to the state, both the question and the institution. There is no equitable or legal title outstanding—this institution is the state's own property, and everyone who has the country's welfare at stake is interested in the question. The entire army of workers will await with increasing concern the determination arrived at by the people's ambassadors.

I can only say that inasmuch as the hand of beauty set the machinery in motion today, I trust the men of Georgia will be too gallant to allow that machinery to stop for want of money only.

The institution represents the great thought of the age wrought into wood and brick and iron; without it, the state will go backward, losing her hold on the power and progress of the present.

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It is the school of the laborer, the workshop of the mechanic, the college of the engineer, the university of the poor. No patent of nobility, of wealth or influence, is necessary to open its doors. If it shall realize the hopes of its founders, there will be no limit to the magnitude of its glory, in the good it shall achieve for the state. Every year it shall send its output of educated muscle and brain into the ranks of the state—each young man a source of unmeasured power, developing wealth and resource, aggregating capital, challenging advance, and constituting

himself a nucleus of thought and of energy, ever increasing, ever developing, ever inviting to grander triumphs. Each one of these educated artisans will become a part in the progress of our state—now a hammer to strike, now an anvil to bear. Like so many hands extended from the body, these young men will work with a heart at the centre, for Georgia's good.

I cannot estimate their value. Into the treasury of the mountains where the coal sleeps, and the iron and gold are locked, they will break with the skilled implements of their trade, and gather the increase for their people.

Beside the cotton fields they will build the factories and plant the machinery which shall utilize for this country and this community the wealth which now goes to swell the coffers of distant lands and nations. Each one with his own hands, in the great, wonderful workshop of the world, will give his time and skill and energy to forge the fitting crown for the imperial brow of this grand old mother state.

The speaker, closing with an eloquent picture of the condition of the South after the war, gave a glowing description of how morning breaks along the rugged cliffs and magnificent mountains of the great Blue Ridge, ushering in the full orbed splendor of the coming day; and prophesied a similar glorious uprising of a new day for his beloved South Land.

Hon. J. J. Gresham, President of the Board of University Trustees, Governor Gordon, Ex-Governor McDaniel, Professor H. C. White, and Mr. Grady, followed with fitting words.

The catalogue * is a handsome pamphlet with a view of the building as frontispiece and with illustrations of the several workshops. From this the following statements concerning the school are taken

"GENERAL INFORMATION.

Extract from the Act of the General Assembly of Georgia, entitled an "Act to Establish a Technological School."

* * * "That there shall be established, in connection with the State University, and forming one of the departments thereof, a Technological School, for the education and training of students in the industrial and mechanical arts.

* * * "That there shall be one beneficiary for each representative in the General Assembly from every county in this State, selected by the Board of Education in each county on competitive examination, and who shall be first entitled to the benefits of said school; that the tuition in said school shall be free to all students who are residents of the State of Georgia. The rates of tuition to others than residents of the State shall not exceed one hundred and fifty dollars per annum."

GENERAL PLAN.

In conformity with this act of the Legislature, the leading object of the school will be to teach the principles of science, especially those which relate to the mechanic and industrial arts.

The school offers an education of high grade, founded on the mathematics, the English language, the physical sciences and drawing, while it gives such familiarity with some industrial pursuits as will enable the graduate to earn a living.

* Annual catalogue of the Georgia School of Technology, a school of Mechanical Engineering. A Department of the University of Georgia. Atlanta, Georgia; organized 1888. Announcement for 1889-'90. Atlanta, Ga. Constitution Publishing Company. 1890. Pp. 44.

There are no elective courses, each student being required to follow the prescribed course, both mechanical and scholastic. The time and attention of students are duly proportioned between scholastic and mechanical pursuits, and special prominence is given to the element of practice in every department.

The methods of the school are in the main such as have been found advantageous in the polytechnic schools of Europe and at the Worcester Free Institute, with such modifications as adapt it to the peculiar needs of this section.

To thorough supervision and instruction in handicrafts are added the stimulus of production for the market, and such other conditions as are likely to be met with in the active business of life. Students do not receive money compensation for their work.

BUILDINGS.

The school occupies a beautiful site in a campus of nine acres, lying at the junction of North avenue and Cherry street, easily accessible by street car lines on Marietta street and on North avenue. The Academic building is a splendid edifice of brick, trimmed with granite and terra cotta, slate roof. It has one hundred and thirty feet front, is one hundred and twenty deep and is four stories high above basement story. It contains ample accommodations in halls, offices, apparatus rooms, recitation and lecture rooms, free-hand and mechanical drawing rooms, library and chapel.

The workshop is also of brick, two hundred and fifty feet long by eighty wide, and two stories high. It is beautifully designed with reference to its use, and affords ample space for the various departments of instruction pursued in it. It contains boiler and engine rooms, wood shop, machine shop, forge room and foundry.

EQUIPMENT.

The Chemical and Physical laboratories have been fitted up with reference to practical work, and such additions will be made from time to time as may be required for experimental research. The apparatus and appliances are of the newest and best forms, and will be increased as occasion may demand.

The workshops have been equipped with machinery and tools from the best makers, and of the latest patterns, at a cost of over twenty thousand dollars. In pursuance of the fundamental idea of giving the student access to the best machinery and experimental knowledge of the best methods of mechanical work, the commission have put the mechanical department on a footing with the most approved and complete shops in the country, and hardly any process requiring fine material and accurate workmanship is beyond its capacity.

The shops of the institution have already won an enviable reputation for the quality of their iron and brass castings, perfection in gear cutting and the beauty and variety of its wood work.

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DEGREES CONFERRED.

The regular degree conferred in this school is that of Bachelor of Science in Mechanical Engineering.

A post-graduate course is being arranged, intended to cover a period of two years, and leading to the degree of Mechanical Engineer.

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TUITION AND FEES.

There will be no charge for tuition to residents of the State of Georgia. All others pay a tuition fee of $150.

Every student, of whatever place of residence, pays an annual fee of $20 to cover

contingent expenses. Half of this amount is payable on the opening day of each term in advance.

A contingent fee of $5 will be required to be deposited with the treasurer on entrance, to cover injury done to college buildings or furniture, which sum will be returned to the student on leaving college, if not forfeited.

The student is advised to defer the purchase of drawing instruments and materials until he can have the direction of the Professor in their selection.

Text-books and stationery can be purchased in Atlanta on good terms. The student is advised, however, to bring such scientific books as he may possess.

DEPARTMENT OF MECHANICAL ENGINEERING.

All instruction in this department is based on strictly utilitarian lines. The graduate's commercial valuation, on leaving the technical school, is invariably based on his helpfulness—on what he can *do*—and not on what he knows. He must *know* things and how to *do* them, and not simply know *about* them.

The studies taught in this department comprise Kinematics and Mechanism, Machine Design, Analytic Mechanics, Applied Mechanics, Materials used in Engineering Structures, Strength of Materials, Steam Engineering, Prime Movers and Laboratory Experiments.

* * * * * * *

The study in Machine Design will be by text-books and lectures, and also by practical applications in drawing. It will include the various parts of machine tools, the steam engine, pumping machinery, electrical machines, riveted joints, and the proper forms for strength and efficiency of the various parts of other machines in common use. A very important adjunct to this course of instruction will be the study of a magnificent collection of blue-prints of details of a large variety of machinery, for which we gratefully acknowledge obligations to the Calumet & Hecla Mining Company, of Boston; to the Dickson Manufacturing Company, of Scranton, Pa., and others. This incomparable collection of prints will be augmented from time to time.

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DEPARTMENT OF MECHANICAL DRAWING.

Mechanical drawing is pursued throughout the entire course of four years, it being considered that efficiency in the drafting room is second only to proficiency in the shop.

The beginning (Apprentice) class first take up free-hand geometric drawing, which is taught by lectures and blackboard exercises. This is followed by free-hand elementary linear perspective, sketching from models, with shades and shadows; sketching both in perspective and orthographic projection, from patterns, castings and parts of machines.

At the middle of the first year the Apprentice class begin instrumental linear drawing, the delineation of geometric curves, etc., from sketches, followed by orthographic and isometric linear projection, the drawing being made from models and to scale. Students are advised not to supply themselves with drawing instruments before consulting the professor in charge. All necessary instruments of the best quality need not cost over $13.00.

Throughout the second (Junior) year Descriptive Geometry is studied, and drawing problems connected with this branch of mathematics occupies four hours per week through the year. Four hours per week will likewise be devoted to mechanical drawing, such as the delineation of various kinds of screws, making copies from detail drawings of parts of machines, making tracings for blue printing, working out problems in isometric and orthographic projection, etc.

The drawing of the third (Middle) year commences with screw, spur, bevel and worm gearing, and all of these branches are fully developed in detail working drawings, to scale, each student, in all cases, being given an original problem, no copying being allowed. During this year also students become familiar with the various processes of photo-copying from tracings, as the "nigrocine," "cyanotype" and "blue" processes, the school being equipped with excellent apparatus for this purpose. They are taught how to properly prepare the paper, as well as make the tracings and points.

The drawing of the fourth (Senior) year is devoted to machine design in detail, in which the methods obtaining in the best modern shops practice is carefully incorporated with purely theoretical considerations. In all the advanced drawing, there is a continual connection between the work done in the drafting room and the instruction given in the class room. At no time is any attempt made to produce pretty pictures which delight the artistic eye of the layman, but which are of no use to any body, for any purpose. Such amateur work is always necessarily far inferior to, and immensely costlier than the work of the photographic camera. All drawing, from first to last, is made accurately to scale, and working dimensions plainly given. In short, an effort is made to teach the student how to make a correct, accurate, working detail drawing.

WORK SHOP PRACTICE.

The shops where the students in mechanical engineering practice occupy a commodious two-story building, 250 feet long by 40 feet wide, with wings 30 by 40 and 12 by 40. The building contains the general offices of the shops, draughting room, iron and wood-working rooms, with tool room for each, paint and finishing rooms, engine and boiler rooms, wash room, forge shop and foundry. All these rooms are well equipped with the best modern iron and wood working machinery and tools.

The shops are organized and managed as a manufacturing establishment, taking contracts for a great variety of work, both in wood and iron, and from this variety of work, always in process of construction, such parts are given the student to make as will afford him the best instruction at that particular stage of his course.

Under this plan the student, growing up in an atmosphere of real business, acquires, besides handicraft with tools, a knowledge of commercial requirements, together with that practical judgment in real work upon which success in life depends. It is expected that at the end of his course the student will be able not only to construct the individual parts of a machine, or design the machine as a whole, but also to so discriminate between methods and processes as to produce a machine that can be marketed, thus fitting him to become a director in the world's industries.

The first, or Apprentice year, is devoted entirely to wood work. This includes a course of elementary instruction in laying out work with knife and pencil, and the use of the ordinary hand tools, such as saws, planes, chisels, etc. This is followed by a course in elementary pattern work, introducing the use of the turning lathe. After these elementary exercises the student works altogether upon practical work, especially pattern and cabinet work. Instruction and practice is given in the use and care of the wood-working machinery, large and small circular saws, band and scroll saws, Daniel's cylinder and buzz planers, boring, mortising and tenoning machines and shaping machines. Two days of nine hours each per week are devoted to practice throughout this year.

The second, or Junior year, is spent in the iron room. During this year the time devoted to practice is one day of nine hours per week, during term time and an additional two hundred hours which must be made up before the beginning of the next year. The students begin work with the simpler lathe operations, such as turning plain shafts, cutting threads, squaring up and finishing nuts, chucking,

reaming, inside borings, etc., etc. The junior year covers the ordinary operations performed with the engine and speed lathes, upright drill, planer and shaper, and turret head screw machine, also the simpler kinds of bench work, such as chipping, filing and laying off work. Squads of students are daily detailed to the foundry, where they receive practice in moulding and in pouring iron and brass, throughout this and the following year.

The third, or Middle year, has the same amount of practice time as the junior year, and the same two hundred hours additional practice. During this year practice is given in the more complicated operations with the lathe and planer and in the use of the universal milling machine, and in gear cutting. During the latter half of this year special attention will be given to tool making and the correct forms for making twist drills, reamers, taps and dies, etc., etc. Students will be detailed to the care of the boilers and engine, including the work of firing and controlling steam pressure and water supply.

The Senior year's practice embraces nine hours, or one day per week. No additional practice is required this year.

During this year the class will build one or more machines complete. Special attention will be given to engineering and planning work, and assembling, erecting and starting new machinery. A portion of the time will be spent in the shop draughting room making drawings and designing tools and fixtures to be built in the shop. Ample opportunity will be given each student to exercise his originality while his work will still be held to well established principles.

The total number of students enrolled is 145; of these, 62 are in the Apprentice, 71 in the Junior, 10 in the Middle, and 2 in the Senior classes. The Faculty, consists of eight Professors; there are four Foremen of the shops. Isaac S. Hopkins, PH. D., D. D., is the President.

THE UNIVERSITY OF ILLINOIS, FORMERLY DESIGNATED AS THE ILLINOIS INDUSTRIAL UNIVERSITY.

The Illinois Industrial University, the State University of Illinois, is situated on "high grounds between the cities of Champaign and Urbana and in the corporate limits of the latter."

The University was chartered in 1866, opened to students in March, 1868. In 1871, it was opened to women students. In 1874, through the personal efforts of President Gregory, then Regent of the University, a fine Art Gallery was established. Accounts of the Art Gallery, and Art School, of this University will be given in later volumes of this Report. The University finds place in this volume as one of the National Land Grant Institutions. It is very completely equipped, with necessary buildings, Museums, Library, Laboratories, Apparatus, and Machinery for its Mechanical Department, etc., and has a domain of 623 acres giving ample extent of farms, orchards and gardens for its Agricultural Department, as well as extensive grounds about the buildings, etc.

The University embraces four colleges, subdivided into schools as follows:

"I. College of Agriculture.

II. College of Engineering. School of Mechanical Engineering. School of Architecture. School of Civil and Mining Engineering.

III. College of Natural Science. School of Chemistry. School of Natural History.

IV. College of Literature and Science. School of English and Modern Languages. School of Ancient Languages.

V. Additional Schools. School of Military Science. School of Art and Design. Vocal and Instrumental Music, Elocution and Photography are also taught, but not as parts of the regular courses."

In all the schools of the College of Engineering, and in the School of Art and Design, the study of Drawing is necessarially pursued through the entire course. It is also an alternate study in the second term of the first year in the college of Agriculture, while the studies of the third year, "Agricultural Engineering and Architecture," and "Landscape Gardening," imply a knowledge of drawing.

In the college of Natural Science, Free hand Drawing is taught in the first year of the course in Chemistry. In the course in Natural History—

"Students, throughout the course, are required to observe for themselves, and to make notes and drawings of their investigations. A series of these drawings, upon a uniform scale, together with the accompanying descriptions, is deposited in the library of the Laboratory. Each student provides himself with suitable pencils, drawing pens, and paper, needles in handles, glass slides for mounting objects, and razor for making thin sections."

In the year 1881–'82, there were 352 students of whom 76 were women.

There were 21 students in Agriculture, 41 in Mechanical Engineering, 41 in Civil Engineering, 3 in Mining Engineering, 14 in Architecture, 42 in Chemistry of whom 1 was a woman, 14 in Natural History of whom 8 were women, 4 special students in Art and Design of whom one was a woman. In all these courses, as we have seen, the study of drawing is pursued.—

The catalogue of the University for 1891–'92,* is a very handsomely printed well classified pamphlet illustrated by photographic views of the main University building, the Laboratories, Museum and Library. Very full information is given in regard to the courses of study in the several Colleges; these courses have all been increased in number during the last decade. The College of Agriculture now includes four separate courses, namely: in "Agriculture," "Veterinary Science," "Horticulture," and "Junior course in Agriculture." A "Graduate School," has, also, been added to the University. The list of Officers of Instruction and Administration numbers 25 Professors, and 16 Instructors and Assistants, with 7 Visiting Lecturers, and a Librarian and Assistant Librarian. There is also a State Laboratory of Natural History, with a staff of five specialists; and an Agricultural Experiment Station, with a staff of ten specialists.

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*Learning and Labor. Catalogue of the University of Illinois. Urbana, Champaign Co., Ill. Post Office, Champaign, Ill. 1891–'92. Published by the University. Pp. 192.

583 students, of whom 89 are women, are in attendance; studying in classes and courses as follows. Drawing in some form is included in most, if not in all the courses.

Summary.

BY CLASSES.

	Men.	Women.	Total.
Resident Graduates	5	3	8
Seniors	41	5	46
Juniors	50	7	57
Sophomores	93	8	101
Freshmen	157	27	184
Preparatory	137	26	163
Special	11	13	24
Total	494	89	583

BY COURSES.

Agriculture	11	....	11
Mechanical Engineering	88	....	88
Electrical Engineering	29	....	29
Civil Engineering	87	....	87
Mining Engineering	6	....	6
Architecture	91	1	92
Chemistry	41	4	45
Natural History	40	13	53
Art and Design	....	7	7
Music	....	2	2
English and Modern Languages	54	45	99
Latin	3	1	4
Classical	12	5	17
Pedagogy	1	....	1
Not Specified	31	11	42
Total	494	89	583

Professor Thomas Jonathan Burrill, M. A., PH. D., is Acting Regent. Besides the Professors in charge of the schools of Engineering and Architecture, the following, instruct in Drawing and Industrial Art.

Frank Forrest Frederick, Professor of Industrial Art and Design. George Washington Parker, Instructor in Wood Working and Foreman. Rufus Anderson, M. E., Instructor in Iron Working and Foreman. James McLaren White, Assistant in Architecture. Edward Spencer Keene, B. S., Assistant in Machine Shop. Edith Adelaide Shattuck, Assistant in Drawing. John Henderson Powell, B. S., Instructor in General Engineering Drawing. Cyril Balfour Clark, Assistant in Machine Shop.

CHAPTER IX.

THE LAND GRANT COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS—Continued.

ANALYSIS OF CHAPTER.

Page.

seven years of experiment having proved the optional courses undesirable—Extracts from Report by State Board of Supervisors in 1882 —There are two University courses, a Classical, and a Scientific, of four years each; and an Agriculturial and Mechanical course, of two years—Drawing is a study in the University courses The course of instruction given in the Stevens Institute, Hoboken, New Jersey, adopted in the workshop—The Agricultural and Mechanical features discussed at length—The pressing immediate needs of practical educational training in the State—The catalogue of 1882, shows an attendance of 159 cadets; an increase of 90 over the previous year—The catalogue of 1890–'91, gives views of the grounds and buildings; which are admirably placed on a bluff overlooking the Mississippi, and are most attractive in appearance—An additional course, the "Latin Scientific Course," is announced—A preparatory school is attached to the college—Details of courses in drawing and in industrial training, and of facilities offered—Col. Johnston called, in 1882, to assume Presidency of Tulane University, in New Orleans—An attendance of 179 cadets recorded in 1890–'91—Faculty comprises 20 Professors and Assistants—There is a State Board of 17 Supervisors, of which the Governor of the State, the State Supt. of Public Education, and the President of the College are *ex officio* members. Col. J. W. Nicholson, President and Professor of Mathematics.

PURDUE UNIVERSITY, LAFAYETTE, TIPPECANOE COUNTY, INDIANA.

The University is located on a farm of one hundred and eighty-six acres, one mile west of the City of La Fayette.

The buildings occupy a commanding situation, and the college grounds, handsomely laid out in park and gardens, comprise twenty acres.

The following extracts from the "historical sketch" published in the Annual Register for 1880–'81, give a condensed history of the young Institution.

HISTORICAL SKETCH OF PURDUE UNIVERSITY.

Purdue University had its origin in the Act of Congress of July 2, 1862, which "donated public lands to the several States and Territories which may provide Colleges for the benefit of Agriculture and the Mechanic Arts." The national grant was accepted by the State of Indiana, March 6, 1865, and a Board of Trustees, with the corporate name of "The Trustees of the Indiana Agricultural College," was organized for the management of the trust funds. * * * *

It was this Board that received the land scrip, amounting to 390,000 acres, and, April 9, 1867, sold it for $212,238.50. By careful and wise management, this endowment fund has been increased to $340,000, invested in a non-negotiable Indiana State bond, bearing five per cent interest, payable quarterly. * * *

At the special session in 1869, an act was passed, May 6, accepting a donation of $150,000 by John Purdue, on specified conditions; a donation of one hundred acres of land, appurtenant to the institution, by citizens of Chauncey; a donation of $50,000 by Tippecanoe county; and donations by the Trustees of the Battle Ground Institute, and by the Trustees of the Battle Ground Institute of the M. E. Church, both made on condition that the College be located at Battle Ground. This act located the institution in Tippecanoe county, at such point as the Trustees might

determine before January 1, 1870, gave it the name of Purdue University, and provided for its organization and management. The location of the University was definitely fixed by the Trustees, December 22, 1869. * * *

The University was formally opened September 17, 1874. * * * *

The plan of organization adopted by the Board of Trustees was based on the theory of special education, and the instruction of the University was distributed among the following Special Schools: I. School of Natural Science, including (a) Physics and Industrial Mechanics, (b) Chemistry, (c) Natural History; II. School of Engineering, including (a) Civil Engineering, (b) Mining Engineering, (c) Architecture; III. School of Agriculture, including (a) Theoretical and Practical Agriculture, (b) Horticulture, (c) Veterinary Science; IV. School of Military Science. Detailed courses of study were adopted and announced in Agriculture, Chemistry, Engineering, and Physics, and Mechanical Engineering.

The University was conducted on this plan of special education for two years, but there seemed to be little demand for the special courses of instruction provided. The only special students received entered the School of Chemistry, and most of these were in preparatory branches in other studies. Nearly all the students entered the preparatory classes. * * * *

REORGANIZATION.

At the meeting of the Board of Trustees, held in June, 1876, President White submitted the plan of organization on which the University has since been conducted. The plan was unanimously approved by the Board.

The University was divided into three departments—the College of General Science, Special Schools of Science and Industry, and the University Academy—as described above in the Register. The College was first organized with but one course of studies, the Scientific Course, so arranged as to be a general preparation, not only for all industrial pursuits, but for the courses in the Special Schools.

In 1879 the College was made to embrace three courses—the Scientific Course, the Agricultural Course, and the Mechanical Course—and the Special School of Agriculture, with its "Experimental Station," and the School of Mechanics, with its workshop, were put into successful operation. It required four years "to work out" the plan outlined in 1876, and described in preceding pages.

The Legislature appropriated $20,000 annually for the two years 1881–'82 and 1882–'83.

The following extracts from President White's Inaugural Address delivered June 16th, 1876, while they set forth clearly the purposes of the reorganization of the institution, treat topics of general interest in the consideration of this new class of educational institutions created by the United States law of 1862.

The act of Congress, donating lands to endow colleges "for the benefit of agriculture and the mechanic arts," has proved an educational Babel. No other statute relating to education, has disclosed such a diversity of views, or occasioned such a confusion of ideas.

* * * * * * *

It must suffice to say that the act of Congress, referred to, clearly expresses three things. The first is that the grant was intended to endow a "college for the benefit of agriculture and the mechanic arts." The second is that "the *leading* object" of the college, thus endowed, is "to teach such branches of learning as are related to agriculture and the mechanic arts. The third is that this is to be done "without excluding other scientific and classical studies," and "in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life.

The Purpose of the U. S. Land Grant.

It is thus seen that the two-fold purpose of the grant was to endow *colleges*—not elementary schools—(1) for the benefit of agriculture and the mechanic arts, and (2) for the promotion of the liberal and practical education of the industrial classes. The one imperative condition is that the teaching of the branches relating to agriculture and the mechanic arts, shall be the leading object, and, as a consequence, that the teaching of other branches shall he made a *subordinate* object.

It is unnecessary to make a more exhaustive analysis of the provisions of the act, since it expressly leaves the *manner* in which these two great ends shall be secured, to the several States. Each college is left free to determine for itself how the two classes of studies specified shall be taught, and how the required subordination of one to the other shall be effected. This is the practical question which now confronts us. How shall this University be organized to meet its obligation to the great industrial interests of agriculture and the mechanic arts? What course of study and instruction will secure the two ends proposed and, at the same time, meet the imperative condition prescribed?

It will assist us in answering these questions if we first settle two other inquiries, which are preliminary and fundamental. What "branches of learning" are related to agriculture and the mechanic arts? Can these branches be made the leading element in the required course of liberal education for the industrial classes?

The branches of learning most directly and closely related to agriculture and the mechanic arts, are the natural and physical sciences, and next to these is the science of mathematics. Inasmuch as the mathematics underlie all the other sciences, as well as every agricultural and mechanical process, the closer relation may be claimed for this science, but no practical error will be made in assigning the natural and physical sciences, with their many applications, to the nearest place.

What is Meant by the Term Liberal Education.

Can these sciences be made a leading element in the "liberal" education demanded for the industrial classes by the act? This will depend on the sense in which the term "liberal" is used. A liberal education is one that includes a knowledge of literature and the sciences generally, and hence there may be two kinds of liberal education. In the one, literature has the leading place and the sciences are subordinate; in the other, the sciences have the leading place, and literature is subordinate. The former is usually called a classical education and the latter a scientific education, the name being determined by the leading element in the course.

It is true that the word liberal, when applied to education, is often used in the narrow sense of classical, but this is not the necessary meaning of the term in the act. It is there used in a more general sense to designate an education that extends beyond the branches relating to the industrial arts, and includes "other scientific and classical studies." A course of higher instruction including the sciences as a leading element, and the languages, literature, and history as a subordinate element, would certainly afford a liberal education for the industrial classes. Such a course is now provided in the popular "Scientific Course" in Michigan University, in the "Course in Science" in Cornell, and in similar courses in other American colleges. The college that provides such a course of instruction, with the required subordination of the branches, clearly meets the condition imposed by the grant. The education thus furnished is at once an adequate preparation for the study of applied science and a good general preparation for the several pursuits and professions of life.

I have led my audience to this conclusion with some care, for just here arises one of the most serious difficulties that beset the land-grant institutions. It is supposed by some that the terms of the grant require these colleges to teach every branch of

learning, and, as a consequence, several of them are making a wide and, may I add, very thin spread of their teaching. They are attempting to do the work of the classical colleges, of schools of science, of polytechnic schools, and, at the same time, to beat about over a large experimental farm. The instruction is cut up into an appalling number of parallel courses, general and special, and the few half-paid professors are used, over and over, if not used up.

It is true that there is nothing in the provisions of the grant to prevent an institution, with a limited endowment, from attempting to play university, but there is also nothing that demands such folly. The common sense view of the grant is that it requires no college, endowed by it, to attempt to do *what it can not do well.* If such a college can do anything to meet its obligation to the industrial classes, it can provide facilities for acquiring a thorough scientific education—at once liberal and practical.

More Schools of Science and Technology Needed.

When this is done, the next wise step is to provide instruction in the Applied Sciences, or Technology. The relation of such instruction to all industrial interests is close and fruitful and the land-grant institution that falls short of this, fails to do what is most needed for the improvement, not only of agriculture and the mechanical arts, but of all industrial interests and pursuits. It is now conceded that the weak point in the educational system of the West is the absence of schools of Science and Technolgy. The public schools, academies, and colleges, are supplying facilities for general education, and they are also doing something in the teaching of general science. What is needed, to supplement these, is a few well-endowed and well-equipped institutions, which shall not only teach general science thoroughly, with so much of language and history as may be needed for efficiency and completeness, but which shall carry this instruction in science forward in thorough courses of applied science, the number of such courses being determined by the appliances and resources of the institution. It is better to teach a few applied sciences well than to teach many in a superficial manner. * * * *

Whatever may be true of other institutions, the policy thus indicated is believed to be the true one for Purdue University. Instead of exhausting its limited resources in doing what is now done by the State University, and the classical colleges, it should make the best possible use of its means in meeting the demand for scientific and technical instruction. It must, of course, meet its obligation to provide a liberal education for the industrial classes, but, as already shown, this imposed obligation does not require it to spread over the entire ground of general education. It must be content to begin with the cultivation of a narrow field, and to do its work so well that it may confidently look to the future to widen its domain and fill the import of its university title.

OBJECT OF THE COLLEGE.

The leading object of the College, in conformity with the act of Congress and the acts of the State Legislature, is to teach the principles and the applications of science.

In its course of instruction it gives prominence to the sciences and their applications, especially to those that relate to agriculture and the mechanic arts; and at the same time the discipline obtained by the study of languages and other sciences is not neglected.

All students are required to study the English language. The Latin, French and German languages are also taught, and opportunity for their study is offered to students in any course.

The special or technical instruction given is thus based on a sound, general education.

The College, in fact, is a distinctive school of industrial science—or Polytechnic Institute—a title which by resolution of the trustees is permitted to be inscribed on the catalogue—and work of great value to the youth of the State is now being accomplished by fitting them, by a thorough science-discipline, in which manual training in the lower classes is made a prominent feature, for the successful and honorable performance of the responsible duties of life.

While every attention is given to the mental discipline of the students in endeavoring to train them to habits of accurate scientific thought, and thus to qualify them for the duties of life, their moral and Christian training will always constitute the prominent care and thought of the Faculty."

This is followed by the statement of the present condition of the College so far as relates to facilities offered in its various courses of study.

LABORATORIES AND FACULTIES FOR INSTRUCTION.

The College now possesses facilities for giving laboratory instruction in applied science in the following departments:

I.—IN AGRICULTURE AND HORTICULTURE.

The farm contains 226 acres and is supplied with illustrated specimens of stock of select varieties.

The agricultural experiment station, established in connection with the College, where experiments and scientific investigations relating to agriculture are daily made, affords unusual opportunities to students to become familiar with agriculture, its defects and remedies.

The Students of agriculture accompany the professor in the field, garden, conservatory, stock-yard, etc., where lectures are delivered in presence of the objects discussed, and during the year exercises in practical agriculture of an educational character are given the students who enter upon this course of study.

II.—IN MECHANIC ARTS.

The laboratory of Mechanic Arts is used as an auxiliary in industrial education, as a school of manual training in the arts that constitute the foundation of various industrial pursuits. The work performed by the students is *instructive* in character, as in any other laboratory, and the classes are taught in sections by a series of graded lessons under the supervision of the professor. In the lower classes of the College each student enters this school, and is assigned three exercises a week, each exercise being two hours long.

The object of this laboratory is not to teach a trade, but to educate, to discipline and train the eye and the hand, as well as the mind, and thus by associating manual and mental training, to thoroughly educate the student for the duties of life, whatever his vocation may be. There is no attempt to teach students special skill in constructing articles of commercial value, but all the exercises are systematically arranged and designed for purposes of education.

The wood department is located in a commodious hall 90 x 50 feet, and is provided with a twenty-five horse power Corliss engine, with indicator, a planer, circular saw, handsaw, two scroll saws, a buzz planer, twenty-four stands with lathe and a full set of lathe tools for each, and thirty benches for carpenter work with the tools requisite for construction.

A brick building, 30x87 feet with two rooms has been constructed especially for instruction in working iron.

One room is equipped with sixteen forges and tools required for a forge depart-

ment, and the other with a cupola furnace, having a capacity of 1000 pounds per hour, a coke oven, a brass furnace, moulding benches and special tools for use in a foundry.

The forge and foundry rooms are furnished with a Sturtevant fan and exhauster, supplied with power from a ten horse power engine, constructed by the students in the Mechanic Arts.

The machine department occupies a brick building 30 x 50 feet, and is equipped with nine engine lathes, one speed lathe, one 20-inch drill press, one post drill, one 16-inch shaper, one 5-foot planer, one universal milling machine, a corundum tool grinder and a small emery grinder.

The chipping and filing department is arranged with benches, vises, and tools for twelve students.

The tool room is well supplied with special tools for use in instruction, including a machine for grinding twist drills.

A Weston dynamo is used at present for lighting the rooms when necessary.

III.—IN PRACTICAL CHEMISTRY.

The chemical laboratory is supplied with new and modern apparatus, and in its entire equipment affords excellent facilities for instruction in practical chemistry.

IV.—IN ELECTRICAL ENGINEERING.

The Electrical Laboratory is well supplied with modern appliances for instruction in electrical engineering. It occupies two large rooms in the basement, and is equipped with a Weston 150 volt, 20 ampere dynamo; one Brush 6 arclight dynamo, with regulator; one Edison compound wound 12 kilo-watt generator; a Crocker-Wheeler one-horse power motor and rheostat and one alternator, made by special students.

The dynamos occupy a separate room from the Laboratory, and are operated by a 32-horse power Westinghouse vertical engine.

The equipment comprises many fine instruments of precision, Sir Wm. Thomson's standard 100 ampere balance, his graded current galvanometer, reading to 600 amperes; also, his graded potential galvanometer, reading to 600 volts, Cardew voltmeter, reading to 150 volts; Weston's standard ammeter and voltmeter; ballistic reflecting galvanometer, mirror galvanometer, Thomson Watt-meter, &c. A battery of fifty-five Julien accumulators has also been installed in the Laboratory. There is also in connection with this department a 10-horse power motor at the experiment station farm a thousand yards from the College, which is run by the Edison generator at the Electrical Laboratory.

V.—IN PHYSICS.

In the College building provision is made for laboratory work in the department of physics.

VI.—IN MINERALOGY.

This laboratory occupies a convenient room in the basement, and is provided with tables and appliances to accommodate thirty students, with an excellent collection of minerals.

VII.—IN BOTANY. VIII.—IN BIOLOGY.

IX.—IN ENGINEERING AND SURVEYING.

The necessary apparatus for field work, including transits, levels, plane table, models of bridges, etc., is provided for the use of the students, and the customary exercises in the field are given.

X.—IN DRAWING.

All the students in the lower classes are required to take drawing, a study which tends to discipline the mind, as well as to train the eye and hand to accuracy of observation and execution. A large, well-lighted drawing room, that will accommodate fifty students, is provided with tables, lock boxes, etc.

MILITARY TACTICS.

Instruction in this department is given in conformity with the act of Congress. * * *

This department is under the charge of Lieut. J. H. Wills, 22d Infantry, U. S. A.

The fact that the college has now a full course of two years in "Electrical Engineering" with a well equipped Electrical Laboratory furnishes, perhaps, one of the most significant indications of the great advance that has been made during the past decade, in the application of the discoveries in science to the practical uses of modern life.

It is an object lesson showing the relation borne by the scientific student, investigator, and inventor, to the practical affairs of mankind.

These views and principles have guided in the re-organization now proposed, and they have been embodied as completely as controlling and underlying conditions would admit.

* * * * * * *

Permit me to add, in conclusion, that the present organization of the University is based on the sound educational principle that special preparation for given pursuits should rest upon a general preparation for all pursuits. All pursuits have a common course of instruction, and the mastery of this common course is the shortest road to a knowledge of those branches which have a special application. Many of the simplest questions of agriculture, for example, require for their solution a comprehensive knowledge of general science, and, besides, the student of agriculture must bring to the task a mind trained to habits of scientific thought and investigation. The superficial empiric, with a little stock of scientific facts in his head, but with no clear insight into their causes and relations, is liable to blunder at ever new application of his knowledge. Even practical facts, to be of practical utility, must be applied by an intelligent mind. * * *

In all our schemes of education, let us not forget that *man* is more important than his work. The engineer must be swifter than his engine, the plowman wider and deeper than his furrow, and the merchant longer than his yard-stick. In education, culture must ever stand before knowledge, and character before artizanship. The highest result of education is manhood.

The following passage is from the first annual Report made by Professor Thompson, Professor of Industrial Art, to the President, and printed in the Report of the University for 1877–'78.

After stating that 100 pupils in the preparatory Academy attached to the University, had received two lessons a week in Free-hand, and in geometrical drawing, and giving in detail the instruction received by the University students, he proceeds to show the relation of the drawing taught in the Industrial Art Department, to the other Departments of the University.

An examination of the work of this department will show that it is altogether indispensable to the existence of at least three of the special schools of the University: the School of Mechanics, the School of Industrial Art, and the School of Civil Engineering. It is also of great assistance in the School of Natural History. Aside from being one of the main supports to these schools that deal especially with the forms of matter, the aim of the instruction has been to prepare students for the different trades and industries of the State rather than to make artists in the ordinary sense of the word. We wish to send forth students prepared to make the drawings of the mechanic or artisan rather than to paint the portraits or the landscapes of the artist. Hence instrumental drawing is placed at the beginning and carried through the entire regular course. Free hand drawing also, which with us takes the forms of decorative design, historical ornament, and drawing from models or nature, is carried along simultaneously with the instrumental course. While this course is undoubtedly the best for the necessary industries of the State, it is probably the very best, as foundation work, for the student of high art. This will be evident when it is understood that the artist and the artisan alike must know *form* and its possibilities. The genius may understand forms through a sort of natural instinct, but the great mass of mankind must study this subject scientifically.

The President in his Report for 1879, announces the opening during the past year of two new schools, the "School of Agriculture" and the "School of Mechanics."

The School Of Agriculture.

The plan adopted in 1878 for the organization of the School of Agriculture includes (1) systematic and thorough instruction and training; and (2) a well directed series of experiments in agriculture. It is a great pleasure to say that *this school is in operation.* It was opened in September last. * * * *

The School Of Mechanics.

The school for practical training in mechanics was opened in October last, and a very promising beginning has been made. The shop is in charge of Mr. William F. M. Goss, a graduate of the department of mechanics of the Massachusetts Institute of Technology, Boston. Mr. Goss is not only a well-trained mechanic, but is familiar with the system of training adopted here. The progress made by the class is evidence of his competency to make the school a success. The shop has been fitted to accommodate five students, the number in the present class, but the fittings may be increased to accommodate ten. Two classes can be instructed each day, and thus twenty students may receive training. The present class began with vise work, and will next take the course in forging. Another year we shall begin with wood work.

In the summer vacation I visited several of the best technical schools in the country to settle important details respecting the course of training in Purdue. The further investigations thus made have strengthened the belief that the instruction or so-called Russian method of teaching mechanics promises better results here than the construction method. The latter requires a much more expensive outfit, and a good endowment to pay deficits in running expenses. I see no reason, however, why each series of lessons in the course may not *end,* with the construction of one or more articles. This would add not only increased interest, but greater value to the training. It is proposed to construct as many of the tools and other appliances needed in our shop as may be possible, and appliances for the several departments

of the University will furnish additional practice in construction. This, however, will not be permitted to interfere with systematic instruction, and training in those elementary processes and arts, which underlie all trades."

The following statement of the courses of study is given in the Annual Register of 1880–'81:

COURSES OF STUDY.

"Purdue University is a college of Science, Agriculture, and the Mechanic Arts. It embraces three departments, designated as follows:

I. *The College of General Science.*

II. *Special Schools of Science, Agriculture, and the Mechanic Arts.*

III. *The University Academy.*

The aim and scope of these departments are indicated below. They are open to students of both sexes.

I. THE COLLEGE OF GENERAL SCIENCE.

The College of General Science provides three general courses of study—*The Scientific Course, The Agricultural Course, The Mechanical Course.*

The aim of the Scientific Course is to give a thorough scientific education as a general preparation for all industrial pursuits; and, secondly, as an adequate preparation for special courses of study. The natural and physical sciences are the *leading* branches in the course, requiring about one-third of the student's time for the entire period of four years. It also gives unusual prominence to industrial art.

The Agricultural Course aims to give a good scientific education, and also to impart a thorough and practical knowledge of agriculture and horticulture. It adds to the instruction of the scientific course (Latin and German excepted) a systematic course of instruction and practice in agriculture and horticulture, covering a period of three years. Special attention is given to scientific experiments.

The Mechanical Course adds to the branches of study in the scientific course (Latin, German, and Natural History excepted) two years of shop practice in the use of hand and machine tools for working in wood and iron, one year's instruction in the elements of carpentry, pattern-making, founding, mill-work, machinery, etc., and one year's training in mechanical drawing—an excellent preparation for a mechanic or machinist, or for a special course in mechanical or civil engineering. These several courses of mechanical instruction and practice are included in the freshman and sophomore years.

These three general courses of study are so arranged that they include nearly the same instruction in science, mathematics, industrial drawing, English, history, and philosophy. In addition to the branches common to the three courses, the scientific course adds three years of Latin or German; the agricultural course, three years of agriculture and horticulture; and the mechanical course, two years of practical mechanics and mechanical drawing.

Students in the agricultural course or in the mechanical course, who are candidates for the degree of Bachelor of Science, (B. S.) are required to take two years of Latin or German. The added Latin or German may be taken in the junior and senior years."

There is a farm of 150 acres for use of agricultural and horticultural students.

Drawing is taught all through the two years course in the Preparatory Academy.

INDUSTRIAL ART.

"This department is supplied with (1) flat copies for outline drawing; (2) flat copies in light and shade for crayon work; (3) colored copies for water color painting; (4) flat copies for carpentry, architectural, and machine drawing; (5) charts to illustrate the botanical analysis of plants for purposes of design; (6) charts to illustrate analysis of historical ornament; (7) charts to illustrate harmony and contrast of color; (8) a great variety of geometrical solids, vases, and casts for model drawing; (9) samples of prints and other textile fabrics, wall paper, carpets, etc., to illustrate the application of design to manufactures; (10) appliances for modelling in clay; (11) potter's wheel for turning pottery; (12) a kiln for burning small clay models and pieces of pottery; (13) an excellent selection of casts from ancient and modern sculpture, recently purchased, including busts of Venus de Milo, Apollo de Belvidere, Diana, Psyche, Paris, Ajax, Michael Angelo, Raphael, and medium sized statues of Minerva, Psyche, Flora, and M. Angelo's Moses; (14) twelve very fine photographs of western scenery, taken under the supervision of the U. S. War Department, presented by Mr. James R. Pigman, of La Fayette. The Library also contains a number of very valuable books of reference and journals for the use of art students." * * *

MECHANICS.

"The School of Mechanics is well equipped with tools and machines for doing a large variety of work in wood and iron; both tools and machines are of improved pattern and first-class in every respect. The machinery is driven by steam power from the engine-house. The shop contains five benches for wood working, with five complete sets of carpenter tools, five power turning lathes, with cutting tools for same; two scroll saws, and other tools for a large scope of work.

The machines, tools, and fixtures for iron work include (1) benches, fitted with Parker vises, sets of files, chisels, hammers, hardened steel squares, gauges, calipers and other tools needed for all kinds of bench work in iron; (2) forges of improved pattern, with air blast furnished by a Sturtevant blower, driven by steam power, and all the common smithing tools, such as anvils, hammers, tongs, chisels, etc.; (3) an engine or machine lathe, a machine planer, of the very best pattern, a vertical drill press, an emery grinder and grind-stone, with a supply of small tools—chucks, drills, taps, and dies, and lathe and planer cutting tools, etc. Additional tools and machinery will be added before the beginning of next year." *

The Register of 1880–'81, shows an attendance of 92 college students, 48 special students, 141 in the Academy, and a total of 254 individual students; 94 of these are girls.

From the Annual Register for 1890–'91, † the following extracts showing the present development of the University, are taken.

GENERAL STATEMENT.

Purdue University is the State Institute of Technology. Its purpose is to afford the young men and women of Indiana an opportunity to acquire a good collegiate education in Mathematics, Science, Literature and Art, and at the same time to

* For a detailed account of this course, prepared by Mr. Goss, the instructor in charge, with a plan of the shops, see Professor Runkle's article on "The Manual Element in Education" in 45th Annual Report of Mass. Board of Education for 1880–'81, pages 171–4.

† The Annual Register of Purdue University. Lafayette, Indiana. 1890–'92. Indianapolis: Wm. B. Burford, Lithographer, Printer and Binder—1891. Pp. 88.

secure instruction and practice in such lines of work as will fit them to engage in the practical industries. The instruction is both theoretical and practical. The usual methods of text-book study, recitation and lectures are employed, but the student is required to put into practice, as far as possible, the instruction which he receives. He, for example, not only receives instruction in regard to the theory and principles of drawing, pattern making and machine construction, but he is required to make working-drawings himself, to construct patterns, to make the castings in the foundry, to finish and set up the machine, and to operate it when it is completed. This combination of the theoretical and the practical characterizes the institution.

Being a State Institution, the instruction in Purdue University is free to all residents of Indiana of suitable age and acquirements. Small laboratory, library and incidental fees only are charged.

The institution embraces Six Special Schools and a Preparatory Department, as follows:

I. A School of Mechanical Engineering. Leading to the Degree of Bachelor of Mechanical Engineering.

II. A School of Civil Engineering. Leading to the Degree of Bachelor of Civil Engineering.

III. A School of Electrical Engineering. Leading to the Degree of Bachelor of Mechanical Engineering.

IV. A School of Architecture. Leading to the Degree of Bachelor of Science.

V. A School of Science. Leading to the Degree of Bachelor of Science.

By *elections* in the Junior and Senior years, this school may be developed into

(a) *A School of Biology.*

(b) *A School of Chemistry.*

(c) *A School of Literature and History.*

(d) *A School of Industrial Art*, in which one or the other of these subjects may occupy the greater part of the student's time.

VI. A School of Pharmacy. Leading to the Degree of Graduate in Pharmacy.

VII. A Preparatory Department.

The courses of instruction in the first six special schools are so arranged that they include, with few exceptions, the same instruction in general science, mathematics, English, history, political and mental science, and industrial drawing. In addition to these branches common to the six schools, the School of Mechanical Engineering adds two years of instruction and practice in practical mechanics and two years of mechanical engineering; the School of Civil Engineering, five terms of instruction and practice in practical mechanics and seven terms of civil engineering; the School of Electrical Engineering, two years of instruction and practice in practical mechanics and two years of mechanical and electrical engineering; the School of Agriculture, four years of instruction and practice in agriculture, horticulture and veterinary science; the School of Science, four years in laboratory work in the natural and physical sciences.

Students in each of these schools are now required to spend in laboratory, shop or field an average of two hours each day in such forms of work or experimental research as will fit them to engage in industrial pursuits.

A careful study of the courses of instruction and practice will show that they embrace a wide range of subjects, and lead to a still wider range of industries. We are thus enabled to recognize, to a considerable degree, special aptitudes and inclinations on the part of the students.

The School of Pharmacy affords instruction in chemistry, pharmacy, materia medica, botany, etc., with a large amount of laboratory practice, for two annual sessions of six months each.

The Preparatory Class offers a thorough drill in the common English branches, quite complete in itself, but which is designed to prepare students to enter either of the first six schools of the University.

Material Equipment.

The University is supported by legislative appropriations and by the proceeds of an endowment granted by the General Government. It derives its name through legislative enactment from John Purdue, who gave to the State for the use of the Institution one hundred and fifty thousand dollars. It has a permanent endowment fund to the amount of three hundred and forty thousand dollars, and other non-productive property in buildings, lands and equipment to the value of four hundred and twenty thousand dollars.

It has one hundred and eighty acres of land in its campus and farm, seventeen buildings, well equipped laboratories, shops, museums, library, and reading rooms.

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Mechanical Laboratories.—These laboratories occupy a number of rooms in the mechanical and electrical buildings, and are equipped as follows:

The *Wood-Working Room* has in it forty benches equipped with separate sets of tools for one hundred students; twenty-one lathes for wood turning that have also tools for one hundred students, a circular saw, a band saw, a scroll saw, two grindstones, and the small tools needed in pattern-making.

The *Foundry* contains thirty small benches furnished with tools required in molding, a cupola furnace for iron, a brass furnace, a core oven, and is equipped with the flasks, sands, facings, etc., required in bench and floor molding. There is a small core room.

The *Forge Room* contains twenty-four forges equipped with smithing tools, and is fitted with blast and exhaust-pipe systems and fans.

The *Machine Room* contains machine lathes as follows: One eighteen-inch swing, screw-cutting; two sixteen-inch swing, screw-cutting; two fourteen-inch swing, non-screw-cutting; eight fourteen-inch swing, screw-cutting, and one ten-inch swing, screw-cutting. Also, a machine planer, a shaper, a universal milling machine, an emery tool-grinder, a cutter grinder, two vertical drilling machines, a speed lathe and an emery grinder. These machines are provided with the small tools necessary to their use. In the *Machine Room* are also twenty-seven benches, fitted with vises and small tools, for use in connection with the hand-work in metal.

The *Wash Room* has lockers for one hundred and twenty students, a sink with basins, and is fitted with closets.

The *Tool Room* is provided with the special tools not used commonly in the various rooms, and with the smaller supplies.

The *Motive Power* for the shops is furnished by an automatic cut-off engine of thirty-five horse-power.

The *Mechanical Drawing Rooms*, three in number, are in the Electrical Laboratory. Two of them are fitted with tables, and drawing-boards, for forty students, each. The third room is fitted with larger tables for advanced work in Machine Design. It will accommodate fifty students.

* * * * * * *

The Art Department.

The lecture rooms and studios of the Art Department are equipped for classes in model and mechanical drawing, wood-carving and china painting. There is attached a library of the leading art publications and other valuable books.

The necessary models and tools are supplied for each line of work.

The drawing room has a seating capacity for classes of fifty and is furnished with materials for work.

Models, Casts, etc.—The wood-carving rooms are furnished with benches and tools which remain the property of each pupil while here. They retain their individual work.

The china painting department has attached a studio kiln where the students may not only have their china burned but may, from observation and experience, learn the principles and understand the workings of this all important factor in relation to their work.

The several schools of engineering offer very thorough courses both of theoretical study and of practical work. The following is the full course of five years in the School of Mechanical Engineering.

School of Mechanical Engineering.

The instruction and practice in this school is intended to train young men for positions of trust and responsibility in engineering work. The work of the first two years is calculated to familiarize them with the methods and processes of machine construction. In the last two years the fundamental principles underlying all machine design are taken up, and a critical study of the action of machines is carried on. The student thus becomes acquainted with the conditions under which designers and managers of important machine plants must work.

FRESHMAN YEAR.

Technical Instruction.—Twenty-seven weeks, three hours per week. Under this head are comprised:

(a) *Recitations* on the character of cutting edges for wood; the care and adjustment of wood-working tools; the shrinkage and warping of woods; and the form, adaptation, and relative strength of joints.

(b) *Lectures* on wood-working machines, including planers; circular, scroll and band saws; and lathes and lathe attachments.

(c) *Lectures* on pattern-making, molding and casting.

Mechanical Drawing.—Twenty-seven weeks, six hours per week; and eleven weeks, ten hours per week.

(a) *Drawings from copy* of the details of machines.

(b) *Drawings* for built-up pulley patterns, pipe bends, laggings, sweeps patterns for sectional molding, and for other work of like character that may be done in the shop.

(c) *Free-Hand Drawings*, with dimensions of details of machines.

Professor Golden and Instructor Nutt.

Shop-Work.—Thirty-eight weeks, ten hours per week.

(a) *Exercises* in planing, sawing, rabbeting, plowing, notching, splicing, mortising, tenoning, dovetailing, framing, paneling, and in other work involving the common carpenter's tools.

(b) *Exercises* in circular sawing, scroll sawing and turning.

(c) *Exercises* in pattern-making, including patterns and core boxes for pulleys, gears, columns, and pipe joints; complete sets of patterns for one or more machines are made by every class.

(d) *Exercises* in core-making, mold-making and casting; also in the management of cupola furnace and crucible furnace in melting iron and brass.

Instructors Hoffman, White and Nutt.

Rhetoric.—Thirty-eight weeks, three hours per week.

Elocution.—Twenty-seven weeks one hour per week.

Geometry.—Twenty-seven weeks, five hours per week.

Algebra.—Eleven weeks, two hours per week.

Trigonometry.—Eleven weeks, three hours per week.

SOPHOMORE YEAR.

TECHNICAL INSTRUCTION.—Twelve weeks, one hour per week.

(a) *Lectures* on the management of steel in forging, hardening, tempering and annealing.

(b) *Lectures* on machines and machine work.

Instructor Turner.

MECHANICAL DRAWING.—Thirty-eight weeks, four hours per week.

(a) *Drawings* to scale from parts of actual machines.

(b) *Ink-shading and tinting.* The representation of flat and curved surfaces by ink tints, and of engineering materials by colors.

(c) *Practice* in the development of problems in descriptive geometry.

Professor Golden and Instructor Nutt.

SHOP-WORK.—Thirty-eight weeks, ten hours per week.

(a) *Iron-forging*, including exercises in heating, bending, drawing, upsetting, welding, annealing, and case hardening. About forty forgings are made, representing a large variety of operations.

(b) *Steel-forging*, including the making and tempering of punches, drills, chisels, machine cutting-tools, gravers and springs.

(c) *Vise work in iron*, including surface-chipping, key-setting, surface-filing, squaring and fitting, round-filing, sawing, scraping and polishing.

(d) *Machine work* in metals, including exercises in turning, planing, slotting, drilling, boring, fluting, etc. This practice is given in the construction of complete machines and appliances.

Instructors Turner and White.

DESCRIPTIVE GEOMETRY.—Nineteen weeks, two hours per week. Instruction in the methods of representing by drawings all geometrical magnitudes, and the solution of problems relating to these magnitudes in space.

Professor Golden.

HISTORY.—Nineteen weeks, three hours per week.

ENGLISH LITERATURE.—Nineteen weeks, three hours per week.

PHYSICS.—Thirty-eight weeks, four hours per week. (See School of Science.)

HIGHER ALGEBRA.—Nineteen weeks, three hours per week.

TRIGONOMETRY.—Nineteen weeks, two hours per week.

ANALYTICAL GEOMETRY.—Nineteen weeks, four hours per week.

JUNIOR YEAR.

PRINCIPLES OF MECHANISM.—Fifteen weeks, four hours per week. Under this head are studied the principles underlying the action of the elementary combinations of which all machines are composed; the communications of motion by gear-wheels, belts, cams, screws and link-work, the various means of producing definite changes of velocity, the different automatic feed motions, epicyclic trains, parallel motions, the principles of quick return movements, and the manner of designing trains of mechanism for various purposes.

Professor Creighton.

MECHANISM OF MACHINERY.—Twelve weeks, two hours per week. A critical study of the mechanism of existing machines with analyses of movements therein presented.

Professor Creighton.

STEAM ENGINEERING.—Twenty-three weeks, two hours per week.

(a) *Valve Gears*, a study of the slide-valve both in its simple form and when used in combination with independent cut-off valves, link-motions and other reversing gears; automatic cut-off gears, including the Corliss and several of the shaft-governed types.

(b) *The Steam Engine Indicator*, including a study of the instrument, its indications, and the conditions to be observed in its use.

Professor Creighton.

ENGINEERING LABORATORY.—Twenty-three weeks, two hours per week. Practice in the manipulation of steam engines, in valve setting and in the use of the indicator. Engines are examined with reference to the distribution of steam in the cylinder; valves are set to give a specified distribution; errors in valve setting are corrected and the power developed is determined. Steam gauges are tested and corrected, and indicator springs are checked.

Professor Goss.

MECHANICAL DRAWING.—Fifteen weeks, six hours per week; twenty-three weeks, eight hours per week. This work is largely supplemental to the recitation-room work in Principles of Mechanism and in Valve Gears. It includes:

(a) Practice in designing pulleys, epicycloidal and involute gear wheels and racks, pin gearing, bevel gearing, lobed wheels, cams, endless screws, and other elementary parts by which motion is transmitted or changed in machinery.

(b) Practice in laying out and in designing steam-engine valves and the mechanism by which such valves are driven.

Professor Creighton.

METALLURGY.—Twelve weeks, two hours per week. This includes a study of the various fuels and refractory materials, their special fitness for different metallurgical operations; the characteristics, composition and location of the principal iron ores, and the modern practice in the manufacture and refining of iron and steel.

Professor Creightou.

HEAT.—Fifteen weeks, four hours per week. Nature and effects of heat, temperature, measurement of heat, expansion, liquefaction, evaporation, latent heat, specific heat, conduction, convection, relation between heat and mechanical energy, principles of thermodynamics. The instruction will be given partly in the class-room and partly by experimental work in the Electrical Laboratory.

Professor Carman.

ANALYTICAL MECHANICS.—Twenty-three weeks, three hours per week.

CHEMISTRY.—General Chemistry, thirty-eight weeks, eight hours per week.

CALCULUS.—Thirty-eight weeks, three hours per week.

SENIOR YEAR.

THERMODYNAMICS.—Twenty-seven weeks, three hours per week. A study of thermal capacities; the laws of thermodynamics; thermodynamics of gases, saturated vapors, and superheated steam; application of thermodynamics to the steam engine; Hirn's equations; and an analysis of the action of injectors, refrigerating machinery, and of gas engines.

Professor Creighton.

STEAM BOILERS. POWER TRANSMISSION.—Fifteen weeks, three times per week.

(a) The various modern forms of steam boilers are studied, and their advantages, disadvantages and the methods employed in their construction noted. The number and size of tubes and flues, the thickness of plates, strength of different styles of riveting, kinds of bracing, amount of grate and heating surface, different kinds of steam and water gages, safety valves and injectors; the causes and methods of preventing foaming, incrustation and corrosion; the manner of setting boilers and of operating them with safety and economy, are studied in detail.

(b) A study of problems relative to the transmission of power by shafting, belting and gearing, and of methods of measuring power thus transmitted.

Professors Creighton and Goss.

Engineering Designs.—Thirty-eight weeks, two hours per week. This work relates to the designing of individual machines and parts of machines, and to the arrangement of machine plants. It includes a study of the adaptation of different materials, the limitations in size and form of machine parts, their relative strength, and methods of connecting and fastening. Existing machines are analyzed relative to the strength of their parts.

Professor Goss.

Mechanics of Fluids.—Twelve weeks, two hours per week. This work includes an investigation of the action of fluids under pressure, the flow of water in pipes, in open channels, over weirs and through orifices; and a study of methods of determining the efficiency of hydraulic machinery.

Professor Goss.

ANALYTICAL AND APPLIED MECHANICS.—Fifteen weeks, five hours per week.

MECHANICAL DRAWING.—Fifteen weeks, six hours per week; twelve weeks, four hours per week. Practice in original designing based on the work of the class. Machinery for performing stated operations is devised, and engines, boilers, and shop machines are designed either completely or in part.

Professor Creighton.

Engineering Laboratory.—Fifteen weeks, four hours per week; twelve weeks, six hours per week; and eight weeks ten hours per week.

(a) Exhaustive steam engine tests by which may be determined such facts as; the power developed, the weight of steam used, the reëvaporation, and the interchange of heat between the walls of the cylinder and the contained steam. This data may be obtained from the compound Harris-Corliss engine in the laboratory, or from either cylinder of the same used singly; it may be obtained with steam jackets in use, or out of use, as desired; with vacuum or with exhaust against atmospheric pressure.

(b) Calorimeter tests for determining the quality of steam.

(c) Steam-boiler tests for determining the evaporative efficiency of boilers of different types under conditions of ordinary use.

(d) The determination of the efficiency of steam and power pumps, when worked under varying conditions of speed, lift and head.

(e) The determination of the efficiency of steam injectors under a definite series of conditions.

(f) Tests of belts for determining the power transmitted and the per cent. of slippage under different rates of speed and different degrees of tension.

(g) Tests of materials of construction, including a determination of the relation between "stress" and "strain," the elastic limit, and the ultimate strength of the common metals in tension; the resisting power of timber under compressional and transverse loads; the crushing resistance of building stones; and the strength, both under tensional and compressional stresses, of cements and cement mortars.

Professor Goss.

THESIS WORK.—Twelve weeks, three hours per week; eight weeks, ten hours per week.

Early in the Senior year each student is assigned a subject which he is to investigate, and on which he is required to prepare a thesis. The work may involve original designs, by which strength and adaptation of parts enter largely into the problem, or it may involve an experimental investigation of the action of certain machines or appliances, or of phenomena developed by the action of certain mechanical forces. In the pursuit of this work the student is thrown largely on his own responsibility. He is expected, so far as is possible, to familiarize himself with whatever literature there may be on the subject, and to study thoroughly the methods he may select.

POLITICAL ECONOMY.—Sixteen weeks, three hours per week.

Visits of Inspection.

During the year the Junior and Senior students make visits of inspection, in charge of an instructor, to the prominent manufacturing establishments of Chicago, Indianapolis and other cities.

It is believed that such trips are of great value in supplementing the work of the class-room and laboratory.

The Register gives a list of 40 Professors and Instructors. The following is the summary of students in attendance.

SUMMARY.

College.		
Graduates	32	
Seniors	35	
Juniors	51	
Sophomores	67	
Freshmen	151	
School of Pharmacy	66	
Irregular	17	
		419
Preparatory Class.		
Regular	87	
Irregular	24	
		111
Total		530

The President of the University is James H. Smart, A. M., LL. D. Besides the several Professors in charge of the regular Schools of Engineering, the following instruct in drawing aud mechanics.—

Earnest Knaufft, Professor of Industrial Art.
Michael Golden, Professor of Practical Mechanics.
Laura A. Fry, Professor of Industrial Art.
William P. Turner, Instructor in Forging and Machine Works
Anna E. Baker, B. S., Instructor in Wood Carving.
James D. Hoffman, B. M. E., Assistant in Wood Shop.
Harry S. White, Assistant in Drawing and Foundry.
George H. Nutt, Assistant in Drawing.

IOWA AGRICULTURAL COLLEGE.

The Iowa Agricultural College is situated near the town of Ames, on the line of the Chicago and Northwestern Railway, thirty miles north of the city of Des Moines.

In 1858, the Legislature passed a law establishing a State Agriculture College; and in 1859, the present site, then a farm of 640 acres, was selected and purchased. "This college and farm were entirely an agricultural institution." Subsequently the legislature accepted the conditions of the National Land Grant law of 1862.

The college, as organized under that law, was formally opened in March 17th 1869. The college farm now comprises some 860 acres, 70 of which are set apart for the college grounds proper.

The college is well equipped with suitable buildings. The total number of students of both sexes in all departments in 1880–'81, was 226.

There is a preparatory course in which drawing is taught. There are four complete courses of four years each, viz: "Agriculture," "Mechanical Engineering," "Civil Engineering," "Veterinary Science.

Drawing is taught through Freshman year in all the first three of these courses. It is taught only in Freshman year in the agricultural course. In the engineering course it is taught throughout the course.

The State Board of Trustees of this college make, biennially, a report to the Governor of the State. The interesting report of the college made by President Chamberlain to the Trustees, which is given in their Report for the 1888–'89,* takes up and considers seriatim, several popular fallacies respecting these U. S. Land Grant Colleges; and, while so doing, shows the great wisdom with which the princely endowment of lands, given by the General Government to the State of Iowa for this educational use, was so well managed that, although the amount of land, (being given in direct ratio to population,) which was apportioned to Iowa, was less than that given to nineteen other States;—yet, so well was this grant managed that, in 1889, the income available from this Land Grant Fund of Iowa, was larger than that of the same fund in any of those nineteen States, with the single exception of the State of New York.

The President thus takes up the popular insufficient idea of the education to be given in these colleges, and says:

> An untold damage to this and every other agricultural college has grown out of the above assumption, that our chief or only mission is to give "instruction in agricultural labor," to teach mere farm processes, ordinary hand-work, requiring merely knack and practice. This assumption has hurt us with the farmers. They have said: "Unless you do that chiefly you pervert trust funds." It has hurt us with those who desire other technological and scientific instruction. They have said: "As you teach only agriculture, we will go elsewhere." The mischief has lurked partly in the name "Agricultural College;" a partial, inadequate, misleading name, adopted, not by Congress, but afterwards, simply for brevity. Three things, not one alone, are required in our organic law: agriculture, mechanic arts, military tactics. The two first are required and made equal; the third is required as an essential. Not "agriculture and the mechanic arts" themselves, however, but such branches of learning as are related to them.
>
> AN INADEQUATE AND MISLEADING NAME.
>
> The name "Agricultural" College is as partial, inadequate, and misleading as would be the terms "mechanical" or "military" college. The exact words of the organic law of Congress are that the interest of the land-grant fund "shall invio-

*Thirteenth Biennial Report of the Board of Trustees of the Iowa State Agricultural College and Farm made to the Governor of Iowa, for the years 1888 and 1889. Printed by order of the General Assembly. Des Moines: G. H. Ragsdale, State Printer. 1889. Pp. 163.

lably be appropriated by each State which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one college, where the leading objects shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislature of the States may provide, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

Referring directly to this congressional law for its authority, the legislature of Iowa, in 1844, passed the following law, still in force, and imperatively regulating our course of study now:

Section 621. That there shall be adopted and taught at the State Agricultural College a broad, liberal and practical course of study, in which the leading branches of learning shall relate to agriculture and the mechanic arts, and which shall also embrace such other branches of learning as will most practically and liberally educate the agricultural and industrial classes in the several pursuits of life, including military tactics.

In absolute fidelity to the letter and spirit of these, our organic laws, as passed by Congress and State legislature, are all the affairs of this College, financial, literary, scientific, and practical, now managed. Not simple processes in agriculture, horticulture, and the mechanic arts, learned better and more cheaply in shop or on farm; not these do we teach largely, but related science, underlying principles, and processes too intricate or difficult for the unskilled, uneducated laborer. Thus alone can we fulfill our true mission."

After stating that, of the graduates of the college of the classes of 1887, and of 1889, two thirds entered the mechanical, agricultural or industrial callings, and less than one third, the professional and mechanical callings; thus showing that the trained abilities of the pupils of this college was given directly to the productive interests of the State, he quotes from an address of General Garfield, who, as a member of Congress, was always a wise, liberal, outspoken and earnest friend of public education.

Garfield on Our Proper Work.

That broad-minded statesman, James A. Garfield, had this to say of proper work, in an address June 14, 1867, five years after the congressional land grants were made, two years before our College began the work of instruction:

"In the next place I inquire, what kinds of knowledge are necessary for carrying on and improving the useful arts and industries of life? I am well aware of the current notion that these muscular arts should stay in the fields and shops and not invade the sanctuaries of learning. A finished education is supposed to consist mainly of literary culture. The story of the forges of the Cyclopes, where the thunder bolts of Jove were fashioned, is supposed to adorn elegant scholarship more gracefully than those sturdy truths which are preached to this generation in the wonders of the mine, in the fire of the furnace, in the clang of the iron mill, and the other innumerable industries which, more than all other human agencies, have made our civilization what it is, and are destined to achieve wonders yet undreamed of. This generation is beginning to understand that education should not be forever divorced from industry—that the highest results can be reached only when science guides the hand of labor. With what eagerness and alacrity is industry seizing every truth of science and putting it in harness."

Then, after two brilliant illustrations—one from the close, scientific study of the nice affinities between carbon and iron, applied in the Bessemer process of marvel-

ously cheapening steel; the other where a knowledge of the cell structure of wood, and the power and penetration of superheated steam, were used to give us cheap wood-pulp for making paper—after these illustrations he continues:

"Machinery is the chief implement with which civilization does its work; but the science of mechanics is impossible without mathematics. But for her mineral resources England would be but the hunting-park of Europe. Our mineral wealth is a thousand times greater than hers; and yet, without the knowledge of geology, mineralogy, metallurgy, and chemistry, our mines can be of but little value. Without a knowledge of astronomy commerce on the sea is impossible; and now, at last, it is being discovered that the greatest of all our industries, agriculture, in which three fourths of all our population are engaged, must call science to its aid if it would keep up with the demands of civilization. I need not enumerate the extent and variety of knowledge, scientific and practical, which a farmer needs in order to reach the full height and scope of his noble calling. And what has our American system of education done for this controlling majority of the people? I can best answer the question with a single fact. Notwithstanding there are in the United States 120,000 common schools, and 7,000 academies and seminaries—notwithstanding there are 275 colleges where young men may be graduated as bachelors and masters of the liberal arts—yet, in all these the people of the United States found so little being done, or likely to be done, to educate men for the work of agriculture, that they have secured from their political servants in Congress an appropriation sufficient to build and maintain in each State of the Union a college for the education of farmers. The scholar and the worker must join hands if both would be successful."

Thus, first he gives the mechanical part of our work, but in the closing paragraph even the broad mind of Mr. Garfield forgot for a moment—misled doubtless by the name—that "agricultural colleges" rest firmly, like the surveyor's tripod, on the triple foundation of agriculture, mechanic arts, and military tactics, and must have that broad and liberal course of scientific, literary and historic study that underlies all three, and that was contemplated by Congress.

OTHER "AGRICULTURAL" COLLEGES.

Some of our sister colleges in other States, swayed, doubtless, by the name in part, and by the local predominance of agriculture, at first seemed to make their mission single rather than triple. It has been the custom of certain agricultural papers to name the agricultural colleges of Michigan, Mississippi, Massachusetts, and Kansas as the only ones that have been true to their organic law and to our industrial interests. They are all noble colleges, and have done a grand and faithful work for agriculture. But it has been a partial work. For nearly twenty years Michigan did little for the mechanic arts or for the military. Recently it has acknowledged its shortcoming, claimed and received large State appropriations for the purpose, built machine shops, and armory and veterinary buildings, created a veterinary department, and made its course of study more nearly what it has been in Iowa from the first. "Not that I love Cæsar less, but Rome more." Not that Michigan "agricultural college" loves agriculture less now, but the other industries more, and is more faithful to her land grant and her organic law.

The Massachusetts "agricultural college," at Amherst, is more purely agricultural than that of Iowa at Ames, but, its land grant was divided at the first, and it has its department of mechanic arts in the "Massachusetts Institute of Technology," in Boston, in which, by law its mechanical students have free tuition paid for by the land grant funds. Mississippi and Kansas are almost exclusively agricultural States. Hence, their "agricultural colleges" are as yet more largely agricultural, and less mechanical than both will become as manufacturing increases with its increased demand for scientific, technological instruction. After a very careful ten

years' study of the workings of the land grant colleges in many States of the Union, I am convinced that in no State have trustees and faculty of the agricultural college held more wisely and persistently, from the first, to both the letter and the spirit of the organic law, than in Iowa. On this point I may speak freely, for I speak not of my own work, but of the work of trustees, presidents, and professors of years ago, who shaped this college. Whether they builded better than they knew, I cannot say. They certainly builded better and more faithfully than the State at large seems to know.

The President then reminds the Trustees that, by the provisions of the Land Grant Law, the State must be at all the expense for the buildings, their preservation and repairs; and goes on to show the need of additional buildings for the college, which, as it is two miles away from the town, and therefore deprived of the power to secure accommodation for students and professors there, is limited to its own facilities; already taxed to their utmost capacity by the 300 students in attendance. He says:

Our income from national sources averages $48,000 per year, besides $15,000 yearly for agricultural experimentation solely. This costs Iowa taxpayers *not a dollar*. By law, it must all be used for instruction, experimentation, and illustration. None can be used for buildings and fixed machinery or apparatus. It seems true wisdom and plain duty for the State to furnish buildings and permanent fixtures and appliances so liberally that this large annual income, which costs the State nothing, may furnish free tuition and industrial training to as large a number as possible of the young men and women of this State. With our income we can teach four hundred students each year as well as three hundred, if only the State will, as it has solemnly agreed, furnish the "necessary buildings."

From a reference in the latest catalogue at hand to a new building, it may be inferred that the President's plea availed with the succeeding legislature.

The catalogue of 1890,* is a handsomely printed pamphlet with illustrations of the commodious buildings and grounds. In continuing the history of the college the following act passed by the General Assembly in 1882 is quoted.

That there shall be adopted and taught at the State Agricultural College a broad, liberal and practical course of study, in which the leading branches of learning shall relate to agriculture and the mechanic arts, and which shall also embrace such other branches of learning as will most practically and liberally educate the agricultural and industrial classes in the several pursuits and professions of life, including military tactics. Section 2. That all acts and parts of acts inconsistent with this act are hereby repealed.

A statement of the law of Congress increasing the annual apportionment to the Land Grant colleges, as has been already referred to in these accounts, follows:

The income of the College from National grants is therefore now more than $75,000 per annum, expended in instruction, experimentation and illustration in agriculture and the mechanic arts and underlying and related science and literature.

All buildings are erected and all repairs thereon are made by the State of Iowa,

*Iowa State College of Agriculture and Mechanic Arts. Catalogue, 1890. "Science with Practice." 1890. By the College, Ames. Pp. 67.

the cost down to date being about $300,000, of which $55,000, appropriated in 1890, is now being used in erecting new buildings.

The College was formally opened on the 17th of March, 1869.

* * * * * * *

Twelve commodious buildings have been erected by the State or are now being erected at a total cost of $300,000, for the exclusive use of the various departments of the College, besides the dwelling houses and the buildings for farm stock, machinery and work.

The main College Building is five stories high including the basement, and is 158 feet long by 112 feet through the wings.

A new building is fitly named "Morrill Hall," in honor of the venerable Senator, Hon. Justin S. Morrill, of Vermont, who has been so thoroughly identified with the whole movement for the establishment and development of the Land Grant Colleges.

The following statement of the course in Mechanical Engineering will serve well to illustrate the relation borne by Drawing and Shop work to the Technical Education given in these colleges.

The Course in Mechanical Engineering.

The course in mechanical engineering assumes the design, supervision and construction of machinery to constitute the engineers' chief work. It aims to furnish, in four years, a thorough fitting to any person wishing to become a professional mechanical engineer. He should, however, have as broad an acquaintance as possible with general studies before entering.

The course is arranged with the view to insuring :—

Complete mastery of fundamental engineering principles;

The actual performance of some engineering work involving scientific methods in construction, investigation and design;

Unceasing contact, from the beginning to the end of the course, with the science of mechanics, its applications, measurements and the study of its law.

Electrical Engineering.—Arrangements have been made to have the instruction in electrical engineering much more complete, hereafter, the student in mechanical engineering being allowed at the end of his Junior year to elect a special group of studies involving in theory and practice of electrical engineering instead of the more technical work of the mechanical course.

While the degree given will be the same as to those continuing the regular studies of the mechanical course, a recognition in the difference in the work done will be made in the wording of the diploma.

The Course and Plan of Instruction.—The student aiming at mechanical engineering as his profession needs first of all to know what engineering is. All available means are taken to familiarize him somewhat with ordinary engineering processes and the highest achievement of great engineers. He is taught by actual measurements of his own, with rule, watch and scales, to find the horse power of the shop engine with simple apparatus, and learns the exact meaning of "work." He measures the power used, and work done by his lathe, and learns the simple relations of "power," "work," "force," "time," and "space," what "mass" is, and what are its relations to the other quantities. He must also have clear ideas of the properties of materials, and soon he is shown how to measure the strength, elasticity and stretch of iron, steel and wood with the testing machine. Other qualities, not capable of precise measurement, become familiar from the work and instruction of the shops.

In the Freshman and Sophomore years the theoretical studies of the course include French as preparatory to the technical use of that language through the first year, and in the second, elementary mechanics and heat taught with special view to their use in engineering. With the chemistry the study of the metals is taken up, while descriptive geometry, graphical statics and the elements of kinematics receive special attention. In the last of the course political economy and English literature are valued as affording breadth and general culture. The differential and integral calculus and the Junior work in electricity and magnetism are preparatory to later technical studies.

The Juniors take up analytical mechanics during their spring term. Besides the purely theoretical side of it, many practical problems are solved, both by calculus and by graphical methods. A thorough understanding of the meaning of each symbol is insisted on and so far as possible of the physical interpretation of the transformations involved in deriving equations. Resistance of materials follows early in the second term, and is made as practical as possible by using engineer's hand-books for the shorter methods of practice as well as by applying the equations for strength, to calculations on beams, girders and bridge members, which the students can see in use about them. Attention is called to the necessity for empirical formulas and the basis for each is studied out.

In the graphics of mechanisms, drawing board methods are taught, for solving problems on the work and efficiency of a great variety of machines, and for the last five weeks of the year one hour daily in class is spent on a general study of the steam engine with boilers and other accessories, while the design for a high speed engine is being worked out in the drawing room.

The technical studies of the first Senior term are thermodynamics and hydraulics for all students; in which the necessary theoretical work is followed by its practical application for obtaining power. The mechanical engineers devote three hours to mill work and the mechanics of mechanisms, studying the arrangements of parts and the principles applied in general mill machinery while the design and construction of the dynamo is taken up by the electrical engineers. In the second term the latter, study applied electricity, accompanied with laboratory work; while the mechanical group study the materials of engineering and the processes of their manufacture, in the class room, and test their physical properties in the mechanical laboratory.

All the engineers study mechanics of the machinery of transmission, involving the application of formulas for strength to various machine parts and an analysis of the methods for driving machines at a distance, also general graphical methods for representing work, velocity and accelerations, and the methods both analytical and mechanical for computing ordinates and areas. A very considerable share of the time is devoted to preparation of the thesis. Each student is required to select his subject early in the year and collect his materials or arrange for any experimental work in good season, and none will be acquired unless showing a very considerable amount of individual work.

PRACTICAL WORK.—As given in this course may be put down under three heads as follows; Shop work, drawing and design, and engineering laboratory work.

SHOP WORK.—Is designed to give familiarity with the arts of engineering by eight or nine hours weekly spent in the shops. While the evident value of making complete articles is recognized, mastery of the mechanical principles involved, and the various capabilities of machine tools is put first.

The following are the subjects taught:

IN THE WOOD SHOP.—Bench work in carpentry and joinery; wood turning, pattern making, and handling of wood working machinery.

IN THE MACHINE SHOP.—Vise work with chisel and file, centering, cutting off, drill press, shaper, planer and lathe work, also hand turning.

IN THE FOUNDRY.—Moulding. melting and core making.

IN THE SMITH SHOP.—Forging, hardening and tempering, and annealing.

To these may be added: Millwrighting and boiler making, the shop system of taking care of small tools, running engines, firing and care of boilers. The material used is furnished the student at lowest wholesale rates, and to cover this expense each one is required to deposit $5.00 at the opening of the term, the balance being refunded at the close. Each student provides himself with a few of the tools he most uses, a list of them being provided at entrance. All others are furnished as needed.

MECHANICAL DRAWING AND MACHINE DESIGN.—This is begun in the first term, Freshman year, and continued throughout the whole course. Careful pencil work is first taught, the figures chosen being such as are involved in later mechanical and graphical constructions. A set of notes giving the principles of machine drawing is also studied and with this drawing from sketches of machine parts made by the student himself.

The drawing of the Sophomore year consists in making complete plates of elementary machine parts from the tables, and formulas, both theoretical and empirical, usually adopted in engineering practice. Professor Klein's book on Machine Design is used through the whole year.

The Juniors have machine drawing and design for two afternoons throughout the year. Link work, valve gear and cam construction are taken up and some time is devoted to the drawings which accompany the study of the steam engine, which begins this year. Each student is also required to design and make complete working drawings of some simple machine which he constructs in the shops during his Senior year.

In the Senior year machine design and drawing consists, first, of the design by the different members, of the parts of the steam engine or such other complete machine as may seem best suited to the requirements or the class, and later, of course, design made by each member as a special study, or in cases where the graduating thesis requires an extra amount of work of this character, such drawing may occasionally be assigned to part of the regular hours for drawing.

In all the drawing, students provide themselves with paper, instruments and all necessary equipments, including the drawing boards used in free-hand work.

A list of the instruments needed is given each member at entrance, and can if desired be supplied to the students at the very lowest rates.

ENGINEERING LABORATORY WORK.—Besides some simple power measurements made early in the course, and the opportunity to see tests of materials and experiments illustrative of principles as they are taught, a special set of experimental tests is made by Seniors, with the help of the Juniors, in their second term. As far as possible the arrangements for these tests are made by the students themselves from general plans furnished.

The standardization of instruments used and system in making and recording observations is taught, as also the need for special care in observing and computing where slight errors would greatly affect the final result, and to the uselessness of carrying exactness of calculations beyond the limits of accuracy of corresponding data.

It is proposed to enlarge and perfect this work as rapidly as the liberality of the State appropriation and the friends of education make it possible.

In this and all work of the course concentration and thoroughness is to be sought before great range of subjects, and unity of effort by making every part of the instruction given illustrate and reinforce every other.

To any who desire more complete information a special circular will be sent on application.

C. W. SCRIBNER, Professor.

About one-third of the students are girls—the following summary of the number of students in each of the different classes and departments is given.

SUMMARY.

Resident graduates	7
Seniors	43
Juniors	55
Sophomores	60
Freshmen	137
Preparatory Class	31
Special Science Students	3
Total enrollment	336

The faculty consists of 25 Professors and assistant Professors and Instructors. Six of these are Ladies. Professor E. W. Stanton was the acting President.

State Agricultural College Of Kansas.

The State Agricultural College of Kansas, at Manhattan, Kansas, was established in accordance with the Land Grant act of Congress, in 1863, and was reorganized in 1872. In 1875 it took possession of its present buildings on the farm belonging to the college, near the city of Manhattan.

The college is open to pupils of both sexes.—Instruction is given in agriculture, horticulture and the industrial arts and in household industries, all students give an hour a day to work at some industry, 276 students attended in 1880, of whom 73 were women.—The course of four years provides a thorough training in English branches in applied mathematics and in chemistry.—In the following statement of studies, the time given is for the entire course.

Trigonometry and Surveying.—The principles of plane Trigonometry, involved in mensuration and surveying, are first mastered. Surveying includes theory, adjustment and use of instruments; history and methods of U. S. Government Surveys; areas of land; dividing land; retracing old lines; platting; topographical surveying; railroad surveying; leveling—section and cross section; computation of earth-work; field practice with transit, compass, chain, level and rod; drawing and ornamentation of plans and profiles."

Mechanics and Engineering.—A careful consideration of the laws of motion and force, as exhibited in all kinds of machines, and in various phenomena of nature, occupies a single term. Another term is given to proper study of materials for buildings, their construction and durability; forms of roofs and bridges; and care and use of machinery.

Drawing.—This study is taught four terms, two of which are in the first, one in the second, and one in the third year. Students that show special aptitude in this direction are permitted to pursue the study during the remainder of this course.

First Term.—Definitions of lines and geometrical figures; judging lines and angles; construction of perpendiculars to given lines, intersecting and bisecting lines, triangles, four-sided figures and polygons, the circle and its secant lines, ellipses, and various geometrical ornaments. Prof. Walter Smith's four books on geometrical drawing are used as text-books.

Second Term.—Free-hand drawing—After the study of numbers 3, 4 and 5 of Prof. Walter Smith's Text-books of Art Education, drawing from nature is taken up. Leaves, flowers and fruits are taken as subjects, and placed in such positions that the perspective will not interfere seriously with a correct perception of form. Each student is required to finish a set of drawings. Lectures on principles and history of ornamentation are given occasionally.

Third Term.—Projection of the straight line and the circle; use of drawing board, T square, and water colors; principles of shades and shadows; principles of parallel and angular perspective; principles of topographical drawing.

Fourth Term.—Projection of the conic sections and other regular curves; intersections of geometrical solids. Each student is required to draw and color a set of plans for a simple farm building, and another set of plans giving details of some farm machine.

Books of Reference.—Warren's Descriptive Geometry, Walter Smith's Manuals on Art Education, Woodward's National Architect, Guild's American Stair-Builder, Andre's Hand-book of Topographical Drawing, Davies' Shades and Shadows.

REPORT OF THE DRAWING DEPARTMENT, 1878–'79.

To the Board of Regents of the Kansas State Agricultural College:

GENTLEMEN—Allow me to submit the following report of the work and instruction of the Department of Industrial Drawing, for the collegiate year of 1878–9.

Five classes have been taught per day, and the number of students enrolled for daily instruction has ranged between fifty-six and ninety-nine. The methods and text-books used have been those of last year. The system of Professor Walter Smith, Art Director of Massachusetts, has been followed through the grades of free-hand drawing in the flat, geometrical construction, perspective and object-drawing. An advanced class of eight male students has, in addition to this, received a course of instruction in the elements of topographical drawing, tinting and mechanical projection. Of all students entering the institution, less than four per cent. had ever had any instruction in this study before. Considering this fact, I feel justified in saying that the advance made by the students has been very satisfactory.

J. D. WALTERS,
Teacher of Industrial Drawing.

MANHATTAN, KANSAS, *June 30, 1879.*

REPORT OF THE DEPARTMENT OF INDUSTRIAL DRAWING, 1879–'80.

To the Board of Regents of the Kansas State Agricultural College:

GENTLEMEN—Allow me to submit the following annual report.

The number of students in my department has ranged between thirty-eight and eighty-eight. Four classes have been taught daily. The plan of instruction has been that followed for the past three years, based upon the admirable system of Prof. Walter Smith, Art Director of Massachusetts. A class of fifteen advanced male students have studied, in addition to Smith's course, the principles of projection. Six students have also solved a series of examples in shades and shadows, from Davies' popular text-book. A part of this advanced work was executed in India ink and water colors, and has been on exhibition in my class-room during the spring examinations, together with specimens of architectural drawing, executed by third and fourth-year students taking drawing as an extra study. I can say, without hesitation, that the advance made by the students of my classes in drawing has been as uniform as that in any other study—a fact disputed by many educators. As a whole, the department is in good working order.

The class in surveying drew a set of topographical plates and a large map of the College farm, under my supervision."

Respectfully submitted

J. D. WALTERS,
Instructor in Drawing.

MANHATTAN, KANSAS, *June 30, 1880.*

In 1874, instead of the regulation catalogue an original publication called a "Hand Book"* was issued. This was a well printed pamphlet in which the ordinary programme of courses taught, with the list of students, was prefaced by some sixty-five pages, containing, first: a copy of the original statement of the policy of the Regents as issued by the Board of Regents in their first Annual Report, and, second: a setting forth of arguments in favor of giving a practical direction to education in this college, and, calling attention especially, to the opening here for girls of such educational opportunities as had not been customary in educational institutions. Many of the latter points argued at length would seem uncalled for in this year of 1893, in view of the multiplicity of educational opportunities now so generally open to women; and in this very fact may be seen something of the extent of the movement towards giving all opportunities to women which has been so marked a feature in the progress of the last twenty years. The arguments for giving specific definite training to the pupil who wishes to become either a farmer, a mechanic, or an engineer; and those showing the value to all of a knowledge of drawing, and of Manual Training, have since become as familiar as household words; but, at the time when President Anderson wrote and published these pages, they had all the surprise of novelty. In explanation of these statements it is said, in an "explanatory" paragraph with which the Hand Book begins, that "radical changes have been made in the Kansas State Agricultural College since the publication of the last catalogue."

The following, which are the closing pages of this statement, will sufficiently indicate the direction and lines upon which it was proposed to develop the institution.

* * * Such are the general principles by which the existing managers of this Institution will be fairly and squarely governed in their effort to provide a liberal and practical education for the industrial classes of Kansas. These principles have been so fully stated in order that all might see whether true premises have been taken and just conclusions drawn. No concealment has been attempted, no issue evaded, no point dodged. We clearly see the line we are following, and believe that it leads directly to a generous mountain looming up in grand proportions and sharp relief against the sky of the future—one which, when finally reached and fully developed, will prove an exhaustless mine of paying knowledge to future farmers, paying skill to future mechanics, self-support and God-birthed liberty to many a brave woman, who, else, must toil as thousands have toiled, and suffer as

*Hand-book of the Kansas State Agricultural College, Manhattan, Kansas. Printed at the office of the Nationalist. 1874. Pp 124.

thousands have suffered all along the dreary past. We are yet a great ways off; with trails to find, roads to build, streams to bridge, long miles to march. It would be much pleasanter to take the eastward train of professional education, and, with genial companions, be smoothly rolled to the New York of professional life. But, being expressly ordered westward to the Rocky range of industrial skill, whither no such train runs, it is evident that a trip to professional New York would only take us that much farther from our journey's end. It would, also, be easier, without examining the orders further than to know that we were to travel, and without especially thinking or caring where a train went, so that it was a train, to fall in with the largest crowd, sit where it sat, and ride snoozingly onwards, convinced that we were right because the crowd was right, and growing characteristically indignant, between naps, at hints to the contrary!

At the close of the first year, we feel that in determining the point of destination much has been done; more, in really starting towards it; and still more in the progress made. Things which, at the outset, were denounced as chimerical, for example, the *teaching* of the trades, are now accomplished facts; and others, which were declared impossible, or, even worse, "unprofessional," have been sufficiently developed to establish both their possibility and each value to the industrial student. Each of the new appliances has worked more successfully than was anticipated; and each position taken has been fully verified by resulting advantages. Many matters that, in the beginning, we all regarded as problematical and experimental are now solid blocks of our faith. The journey is very far from being ended; but, conscious of having done all that it was in our power to do, and more than satisfied with the results, we are content with the past and buoyant for the future.

DIFFERENCE OF PURPOSE AND METHOD, STATED.

The difference between our line and that of other Agricultural Colleges seems to be this: They take as an objective point the graduation of agricultural experts, who shall act as missionaries to working farmers. We take as an objective point the graduation of a capable farmer, able to make his living by farming. Their theory is that of the Normal School, training teachers who shall instruct scholars; our theory is that of training the scholar. Along the mechanical branch, they seek to graduate master builders or superintendents of machine shops; we seek to graduate intelligent and skillful carpenters, masons or blacksmiths. They strike directly for those industries considered the highest, and believe that in reaching them they include all below; we strike for the industries most commonly followed in this State, and by successfully mastering them expect to climb up to the very rarest. Their mode may be best for them, and we are not in the least criticising it; ours seems best for us. Kansas is neither New York, Massachusetts nor Ohio; and we shall not endeavor to reproduce their Agricultural Colleges. With us, where five agricultural scientists can make a living as such, five thousand capable farmers can far more than make a living; and where five architects or master mechanics can obtain employment, five times as many mechanics can command wages. We aim to provide a Kansas State Agricultural College, for the practical education of those who desire to follow industrial vocations.

In so doing, nothing of educational experience that is useful will be rejected because it is old; nor anything retained simply because it is practiced by literary colleges in educating for the professions. That which upon fair trial best serves our purpose will be employed; and that which does not will be discarded, though it were bald-headed with antiquity. Nothing will be attempted rashly; nothing clung to because once introduced; and nothing refused trial that promises effective aid in reaching and working the mine. And these statements apply not merely to the course of study, but to all methods and regulations. The management of such

an endowment, for the accomplishment of such a purpose, is so weighty a responsibility that, neither because of public favor nor public criticism, can we afford to deviate from those measures which, in our judgment, will soonest and best execute the purpose of the grantor. So long as we act at all, we shall act as executors of the will; and, being justly held responsible for our deeds as such, we propose to do our own thinking and our own deciding. Whether the will be the best that could have been made, is none of our business; we are simply executors—though we believe that it is. Whether the youth of Kansas want an industrial education, is equally not our business; we are bound to furnish it to those applying, but not to make any one apply—just as a post master is bound to keep stamps for sale, but not to make people buy stamps. As the government pays its post masters, so the congressional endowment pays the salaries of those whom we employ; and the instruction given by them is furnished to all absolutely without charge or contingent.

We have just stated our understanding of the object and provisions of the national will; the principles by which we shall be guided in executing it; and the reasons for the adoption of these principles. If the people, through their servants and our superiors, the law-making and law-enforcing officers of Kansas, desire that the national will shall be so executed, we ask their support, and material aid in the form of buildings and appliances, which, in accepting the grant, they contracted to furnish. If they do not so desire, but wish the enterprise conducted upon other and antagonistic principles, our resignations are most heartily at their service—that those who have better ways may be able to try them, on their own responsibility; we will not take the risk. Whatever else may yet need to be tried, there is no use in repeating the experiment of flying a literary kite with an agricultural tail, so often made in various quarters. It is a pleasant regential and professional amusement, and quite attractive to an immediate locality; but there is not a cent of money in it for the industrial student, whose estate pays for the kite. The fact that, out of some six hundred students attending Cornell University last year, only two were studying agriculture; and that, of all those at Harvard, but two were in its Agricultural school, is enough for us. What the brain, pluck, experience and unlimited cash of New York Cornell and Bostonian Harvard have not effected, we, at least, shall not attempt in Kansas. The best appliances that money can buy are there, and at a dozen other institutions, but the results are the same. And there is no particular sense in butting at a stone wall—as a regular business.

PRESIDENT ANDERSON'S IDEAL OF AN AGRICULTURAL COLLEGE PORTRAYED.

Some day and somewhere, there will be an Agricultural College looking so much like the grounds and buildings of a prosperous farmer who did his own repairing and manufacturing, that we of the present, happening by, would mistake it for a little hamlet of thriving artizans built in the heart of rich and well tilled fields. Nothing in its appearance would suggest our notion of the typical college. Its barns, sheds, yards and arrangement would embody the idea of the greatest utility at the least cost. Its implements, stocks and fields would show them to be used for real profit. Its orchards and gardens would not only reveal the success of the owner, but, also, his full determination to enjoy the fruit with the labor. We would be quite certain that it was only such a farm—the best specimens of the highest type—were it not for the presence of cheap, stone buildings, one or two stories, scattered among the trees, all of them more resembling mechanic's shops than anything else; some, exactly; others, not exactly; and yet no two alike. One would be used for teaching practical agriculture, but would as little prompt our idea of a recitation room, as the whole cluster would that of an imposing edifice. While there would be seats for hearers and a place for a speaker, yet the latter would most suggest a circus ring for the exhibition of short-horns, when short-

horns were discussed; of horses, pigs or sheep; of surgical operations; of plows, harrows or reapers. The walls would be lined with photographs of famous herds, working models of farm machinery, the grain and stalk of cereals. Part of its surrounding ground would be belted with every variety of growing grasses; and another would be for the draft-test of implements, or the trials of student skill. In fact, it would so look, and so be, like an actual workshop of real farming as not, even in the remotest way, to squint toward the article generally y'clept "scientific agriculture." The interior of another shop, a few rods distant, and equally inexpensive, with its grafting tables, potting benches, packing rooms, working greenhouse, and, outside, hotbeds and thrifty nursery grounds, would look so much like "gardening for profit" as to throw us completely off the trail of botany as a pure science. Another, would be a force shop, where light, heat, water, sound and electricity were made to reveal their laws, habits and effects, and to do their industrial work. The constant use of its appliances by busy students, in sacrilegious defiance of the rule, "*don't* touch the apparatus!" italicised with professional emphasis, would instantly satisfy us that there was nothing "collegiate" there, and that it was only a workshop where pupils had to become skillful work-men! There would be a mathematical shop, so much like a counting and drawing room, that when it led into an inventor's and pattern maker's room, no one could be surprised at its winding up in a machine shop. There would be an English shop, remarkably like a printing office; and the "Printer's Hand Book" of that day might strike us as an admirable drill in the art of using the English language, as well as in that of sticking type—almost as good as a grammar! There would be a woman's workshop, where the pale Hortense, at heart a good deal more sensible, earnest and womanly than society supposes, would strive for the bloom and 'faculty' of Mary. The blessed Mrs. Grundy would be dead! And there would be mason's, carpenter's and smith's shops. Not a shop of them all would cost $5,000; and some, not the half of it; because they would be shops, warm, light, cheerful, but workshops—not requiring costly foundations and tall, heavy walls, not furnished as are parlors, nor wasting space in broad corridors. And they would not have been foreordained by men of a previous generation, who, to save the lives of the best of them, could not possibly have foretold just what buildings such a college would need. As, in the process of its growth, a want had been felt, its shop was supplied, and each generation had footed its own bills. No! it would not look like our great colleges; but very remarkably like a nest of real educational workshops, where flesh and blood students acquired marketable skill for industrial labor. In it, drill in the art would have greater prominence than the stringing of facts on the threads of a system; and the requirements of the art would serve as a skimmer to lift the cream of science as needed. Knowledge would be shoved prying end first, and not, everlastingly, philosophic end first. For the world would have gotten back to the history of its own experience, where art was the Columbus discovering science. In it, educational common sense would have supplanted uncommon educational nonsense. And leaving it, the newly fledged graduate, as does the newly fledged "jour.," would at once earn a living. Such an Agricultural College would be in keeping with its object, with the requirements and genius of labor, with itself! And too, it would be in keeping with a rich, broad State, carpeted by emerald grasses, belted by golden grain, clumped with orchards, moving with herds, clustered with villages, threaded by railways, flecked with countless smoke-offerings from the altars of industry to the God of labor.

Some day; somewhere; somehow.

The catalogue for 1890–'91,* has in addition to the frontispiece,

*Twenty-eighth Annual catalogue of the officers, students and graduates, of the State Agricultural College of Kansas. 1890–91. Manhattan, Kansas. Topeka. Kansas Publishing House; Clifford C. Baker, State printer. 1891. Pp. 62.

which is a view of the main building, six interesting full page illustrations, showing the pupils busily at work in the various laboratories and work shops.—These are evidently process reproductions of photographs; the views are of the Chemical Laboratory; The Drawing Room with its casts of Statues and Busts; The Carpenter Shop; The "Kitchen Laboratory;" The Printing Department and the Sewing Department.

The following paragraph prefaces the particular description of the several buildings, this is accompanied by a full page plan of the farm, showing the location of the buildings.

The College grounds and buildings, occupying an elevation at the western limits of the city of Manhattan, and facing towards the city, are beautiful in location. The grounds include an irregular plot in the midst of a fine farm, with orchard, vineyards, and sample gardens attached, the whole being surrounded by durable stone walls. The grounds are tastefully laid out and extensively planted according to the design of a professional landscape gardener, while well-graveled drives and good walks lead to the various buildings. All of these are of the famed Manhattan limestone, of simple but neat styles of architecture, and admirably suited to their use.

The following statements show the resources of the college and its methods.

OBJECTS AND METHODS.

ENDOWMENT AND RESOURCES.

An act of Congress approved July 2d, 1862, gave to each State public lands to the amount of 30,000 acres for each of the Senators and Representatives in Congress according to the census of 1860, for the "endowment, support, and maintenance of at least one college, where the leading objects shall be, without excluding other scientific and classical studies, and including military tactics to teach such branches of learning as are related to agriculture and the mechanic arts, * * * in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

Under this act the State of Kansas received 82,313.53 acres of land, and, in 1863, established the State Agricultural College, by endowing with these lands Bluemont College, which had been erected two miles from Manhattan under the auspices of the M. E. Church, but was presented to the State for the purpose named in the act of Congress.

In 1873 the College was reorganized upon a thoroughly industrial basis, with prominence given to practical agriculture and related sciences; and in 1875 the furniture and apparatus of the College were moved to the farm of 215 acres, one mile from the city of Manhattan. On this fine location the State has erected buildings valued at $135,000, of which a description is given elsewhere. The farm and grounds, furniture, stock, and other illustrative apparatus are valued at over $130,000. All the lands have been sold, giving a fund of $501,426.33, which is by law invested in bonds, the interest alone being used for the current expenses of the College.

The annual income from the endowment fund—about $32,000—is supplemented by an appropriation under an act of Congress approved August 30, 1890, of $15,000 for 1890, $16,000 for 1891, $17,000 for 1892 and a sum increasing each year by $1,000 until the annual amount shall be $25,000. This fund is "to be applied only to in-

struction in agriculture, the mechanic arts and the English language, and the various branches of mathematical, physical, natural, and economic science, with special reference to their application in the industries of life, and to the facilities for such instruction." "No portion of said moneys shall be applied directly or indirectly, under any pretense whatever to the purchase, erection, preservation or repair of any building or buildings."

All expense of instruction is thus provided for, and the State is left to erect the necessary buildings and meet expenses in management of the funds.

Under an act of Congress, approved March 7th, 1887, the College received, by general appropriation in Congress, $15,000 each year for the maintenance of an Experiment Station "to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science." The property of the station, including a building erected especially for its use, amounts to more than $10,500.

OBJECTS.

This College now accomplishes the objects of its endowments in several ways:

First, it gives a substantial education to men and women. Such general information and discipline of mind and character as help to make intelligent and useful citizens are offered in all its departments, while the students are kept in sympathy with the callings of the people.

Second, it teaches the sciences applied to the various industries of farm, shop, and home. Chemistry, botany, entomology, zoölogy, and mechanics are made prominent means of education to quick observation and accurate judgment. Careful study of the minerals, plants, and animals themselves illustrates and fixes the daily lessons. At the same time, lessons in agriculture, horticulture, and household economy show the application of science; and all are enforced by actual experiment.

Third, it trains in the elements of the arts themselves, and imparts such skill as to make the hands ready instruments of thoughtful brains. The drill of the shops, gardens, farm, and household departments is made a part of a general education to usefulness, and insures a means of living to all who make good use of it. At the same time it preserves habits of industry and manual exertion, and cultivates a taste for rural and domestic pursuits.

Fourth, it strives to increase our experimental knowledge of agriculture and horticulture. The provision for extensive and accurate researches made by establishing the Experiment Station as a distinct department of the College, offers assurance of more definite results than can be obtained by ordinary methods.

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Fifth, it seeks to extend the influence of knowledge in practical affairs beyond the College itself. For this purpose it publishes the weekly *Industrialist*. Its officers also share in the debates and consultations of farmers and horticulturists throughout the State. Each winter a series of ten Farmers' Institutes is held in as many different counties of the State. In these the Faculty share with the people in lectures, essays, and discussions upon topics of most interest to farmers. These institutes have brought the College into more direct sympathy with the people and their work, so as to make possible a more general dissemination of the truths presented; and permanent organizations for the same purpose in many counties are increasing. Correspondence upon such questions is invited by all members of the Faculty, and applications for institutes are desired from all parts of the State.

COURSE OF STUDY.

The necessity for so adjusting various branches of a course of study that there shall be as little waste as possible in acquiring both information and discipline, is felt by every teacher. Such a course is not designed to be absolutely inflexible, but

to guide the judgment into some definite line of progress from which no mere whim shall turn a student aside.

Each student is expected to take three studies besides one hour's daily practice in an industrial art; and variations from this rule can be made only with the consent of the Faculty.

Parallel courses are offered to both sexes, with such differences as their necessities seem to call for.

Full detail of the courses of study are given. The following shows the attention given to those studies with which this Report is concerned and also a general view of the routine of the pupils work.

INDUSTRIAL TRAINING.—Closely adjusted to the course of study is industrial training in several of the arts, to which each student is required to devote at least one hour a day. Among the lines of training each student may select, with the approval of the Faculty, except in terms when special industrials are required. Youug men may have Farming, Gardening and Fruit-growing, Carpentry, Cabinet-making, Iron-work, or Printing. Young women may take Sewing, Printing, Floriculture, or Music.

All young men must have their industrials for one term in the carpenter shop before completing the first year; and during the spring term of the second year and the fall term of the third year, upon the farm, garden, and orchards. Young women take their industrial for one term of the first year in sewing, and for the winter and spring terms of the second year in the kitchen laboratory and dairy.

The daily routine requires chapel at 8:30 A. M., and classes from 8:50 A. M., to 1 P. M., as shown under "Class Hours." Class rhetorical exercises are held weekly. Military drill is twice a week. On every Friday afternoon, at 1:30, all attend the public lecture or rhetorical exercises in chapel.

The details of the courses in Drawing are practically the same as already given from the catalogue of 1880. The following gives the special training in Industrial Arts.

INDUSTRIAL ARTS.—The training in these departments is designed to be systematic and complete in each, so that the student, following a single line diligently through the four-years course, gains the essentials of a trade and a reasonable degree of skill. Those who wish only a general acquaintance with the arts can take shorter courses in several of them; but all are to select with a definite purpose. In the established course, young men are required to take the regular term in the carpenter shop, and on the farm and gardens, whatever the industrial chosen; young women are required to give one term to sewing, one to practice in the kitchen laboratory, and one in the dairy.

AGRICULTURE AND HORTICULTURE are required of young men as industrials during one term of the second year and one term of the third year. In these, practice is made to illustrate and emphasize the teaching, and cover essentially the same ground.

COOKING.—During the winter term, the young women who have lectures on Household Economy are required to cook one hour each day. They are taught various methods of making the substantial articles of food, as well as allowed to spend some time on the dainty dishes. During the term, they have practice in waiting on the table, in serving guests, and in arranging for evening companies, thus putting into immediate practice the lectures of each day.

During the fall term, any students who have passed the study of Household Economy may take cooking as an industrial, in which canning fruits, making preserves, jellies, pickles, mince-meat, desserts, cake and fancy breads form the principal part of the work.

DAIRYING.—During the spring term, daily instruction and practice in domestic dairying are given the young women of the second year by the Instructor in Household Economy. Here the regular daily work is supplemented by a short course of lectures intended to explain the best practice in the arts of butter- and cheese-making, and to give the reasons therefor. The following topics cover, in the main, the instruction given the class: Influences affecting the quality and quantity of milk; butter-making; creameries; "deep" and "shallow" setting systems; packing and preserving butter; the household and factory systems of cheese-making.

CARPENTRY.—Wood-work is required of all young men during one term of the first year. In the first term's work a definite graded series of tasks is given in joining, work to dimensions, and simple problems in construction and turning, with the proper use and care of common bench tools, through which each student is advanced according to ability. Practice is given later in general wood-work, carpentry, cabinet-making, turning, and pattern-making; and the advanced students may have work suited to their chosen line, with special problems of construction, and special training in the use and care of fine tools, including saw-filing. All work during industrial hours is laid out by the Superintendent, and belongs to the shop, except that fourth-year students are allowed to work from drawings of their own upon articles for their own use or profit. All students may be allowed the use of the shop outside of the practice hours for work of their own, under direction of the Superintendent.

In iron-work, instruction is given in ordinary work—forging, filing, tempering, etc.

SEWING.—One term of sewing is required before the completion of the first year of study. During this term the work is carefully laid out by the Superintendent in a series of lessons, graded to the capabilities of each student. To more advanced students all ordinary forms of sewing with needle and machine are taught, and any student may furnish material, and work for her own advantage under direction of the Superintendent. Cutting and fitting by a straight-line system are taught, and the systems are furnished at wholesale rates. Fancy needle-work and knitting may be taken at certain stages of the course.

PRINTING.—Two courses are pursued in this art. In one the student is taught the use of the implements or tools used in typography; composition and imposition; correcting proof; technical terms: presses and their workings; and the general duties of a first-class workman. The other course of lessons embraces instruction in spelling, capitalization, syllabication, punctuation, proof-reading, and such other work as will make the student accurate and expert. Wilson's Punctuation is the text-book; but much of the instruction is oral—such as grows out of the every-day experience of the office.

Admirable drill is furnished by the *Industrialist* to all, but especially to those who take the full course. The printing which the departments of the College require gives to the advanced student a fair knowledge of the principles and practice of job-work.

Books of Reference.—MacKellar's American Printer, Harpel's Typograph, Ringwalt's Encyclopedia of Printing, DeVinne's The Invention of Printing, DeVinne's Printers' Price List, the *Inland Printer*, *American Art Printer*, *Superior Printer*, *Paper and Press*, *The American Bookmaker*.

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LABOR AND EARNINGS.

Every encouragement is given to habits of daily manual labor during the College course. Only one hour of daily practice in the industrial departments is required; but students are encouraged to make use of other opportunities for adding to their ability and means.

All labor at the College is under the direction of the Superintendents of the departments, and offers opportunities for increasing skill and efficiency. In regular weekly statements, the students are required to observe business forms and principles, showing from their daily account when and where the work was performed. The shops and offices are opened afternoons and Saturdays for the accommodation of skilled students in work for their own advantage. Everywhere the student who works wins respect; and it is a matter of pride to earn one's way as far as possible.

The labor of the students in the industrial departments is principally a part of their education, and is not paid for unless the student is employed upon work for the profit of the College. Students are so employed upon the farm, in the gardens or the shops, and about the buildings. The labor is paid for at rates varying with services rendered, from eight to ten cents an hour. The Superintendents strive to adjust their work to the necessities of students and give them the preference in all tasks suitable for their employment. So far as practicable, the work of the shops and offices is turned to account for their benefit; and the increasing extent of the grounds and sample gardens brings more of such labor. The monthly pay-roll for the past year ranges from $250 to $400.

Many students obtain work in the city or upon neighboring farms, and so pay part of their expenses. In these ways a few students are able to earn their way through College. The amount so earned will vary according to the tact and zeal of the student. The majority must expect to provide by earnings outside of term-time, or from other sources, for the larger part of their expenses. The long summer vacation of three months offers opportunity for farm or other remunerative labor; and no one need despair of gaining an education if he has the ability to use his chances well.

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The following statement shows the success of the College since its foundation as an educational Institution:

SUMMARY.

During the twenty-eight years of its existence the College has received over three thousand students, about a third of whom were young women. Most of them have come from farmers' homes, and after from three months to three years of study, have gone back to such homes without graduation.

The number of graduates up to 1890 is 232, of whom 73 are women. Graduates previous to 1877 pursued, with two exceptions, a classical course, and received the degree of Bachelor of Arts. Since 1877, all have received the degree of Bachelor of Science after a four-years' course in the sciences, with good English training.

The attendance of pupils for the year 1890–'91, is given as follows:

SUMMARY.

	Gentlemen.	Ladies.	Total.
Post-graduate	6	6	12
Fourth-year	31	22	53
Third-year	38	12	50
Second-year	80	55	135
First-year	217	126	343
Total	372	221	593

The Faculty consists of 18 Professors and Instructors, with 6 Assistants and Foremen, and 8 "Student Assistants." George T. Fairchild, A. M., is the President.

The Agricultural And Mechanical College Of Kentucky, Lexington, Kentucky.

The State of Kentucky, by act of January, 27th 1863, accepted the national land grant under the conditions of the United States Law of 1862.

In 1865, the Legislature established the college as one of the colleges of the Kentucky University, which had come into possession of the grounds,—(some twenty acres),—and buildings of the Transylvania University, at Lexington. Through the efforts of J. B. Bowman, regent of the University, the sum of $100,000 was contributed by citizens; for the purchase of the estate of "Ashland," formally belonging to Henry Clay, and comprising 433 acres, of the finest farmingland; and of the adjoining farm of "Woodlands," in immediate vicinity to the City of Lexington. This was to be the site of the University and of the new Agricultural College. The college was opened two years after the passage of the act consolidating it with the University, and 190 students attended its first session. Regent Bowman claims that it was the first college actually in operation under the United States grant of 1862. In the Report of the Regent to the Governor, December 28, 1868, the history of the establishment of the College was given at length, and the whole subject of the design of Congress in passing the law was ably argued. In conclusion he sums up in favor of the plan making the proposed "Colleges of Agriculture and the Mechanic Arts," Departments of Universities already established.

Full schedules of the ten courses of Instruction are given. The following comprise the studies with which this Report is concerned.

VIII. SCHOOL OF CIVIL ENGINEERING AND MINING.

Professor Eyraud.

In this school will be taught Geometrical and Topographical Drawing, Tinting, Shading, and Lettering; Descriptive Geometry; Linear Perspective; Shades and Shadows; Practical Astronomy; Road Engineering; the use of Engineering Instruments; Leveling; Architectural Drawing; Geology of Mining Districts; Metallurgy; Mining Engineering; Construction of Furnaces; Determination; Mineralogy and History of Mining Operations.

IX. SCHOOL OF FINE ARTS.

In this School will be taught Music, Drawing, Painting, and Landscape Gardening.

In accordance with the act of the Legislature passed the previous session, severing the connection between "the Kentucky University" and the "Agricultural and Mechanical College of Kentucky," the Board of visitors met at Lexington, July 12th, 1878, and re-organized the college as a separate institution;—selecting from the estate one hundred acres of land to which, by agreement between

the authorities of the University and the State Commissions, the college was entitled for two years. The final location of the college rests with the General Assembly of the State.

The following statement of the first year of its separate existence is from the annual report of the President to the Governor of the State for 1878–'79.—

The success of the Agricultural and Mechanical College during the last year—the first year of its existence as an independent Institution—has far exceeded the expectations of its Board of visitors and Faculty. During the year 1877–'8 it had but *seventy-eight* matriculates. It closes the present collegiate year with *one hundred and eighteen*—an increase of over *fifty per cent.* For years past it was alleged to have brought the Kentucky University, with which it was connected, annually into debt. This year it has paid all expenses, expended a considerable amount on student labor, made ample provision for preparatory instruction by tutors, and although it has realized, as yet, comparatively nothing from this, its first year's crop, has, at the close of the present fiscal year, an unexpended balance in the Treasury. These facts prove that an Agricultural and Mechanical College can be conducted economically and successfully, even upon the small income derived from the Congressional scrip fund, which, up to this time, constitutes its sole endowment.

Each Legislative Representative District in the State is entitled to send one properly prepared student each year, between the ages of twelve and twenty five years, to this college, free of tuition.

The schedule of courses of Instruction enumerates eight schools. Drawing nowhere appears as a study, though, as Civil Engineering and Military Engineering are comprised under the "School of Military Tactics and Civil Engineering," there must needs be some training in Mechanical drawing, at least.

This arrangement was but for two years, and the Legislative Commission was directed to report to the Legislature of 1879–'80, "a plan of organization for an Agricultural and Mechanical College, such as the necessities of the Commonwealth require.

The city of Lexington offered to the Commission (which was also authorized to recommend to the General Assembly the place, which, all things considered, offered the best and greatest inducements for the future and permanent location of the College) the City Park, containing fifty-two acres of land, within the limits of the city, and thirty thousand dollars in city bonds, for the erection of buildings. This offer the county of Fayette supplemented by twenty thousand dollars in county bonds, to be used either for the erection of buildings or for the purchase of land. The offers of the city of Lexington and of the county of Fayette were accepted by the General Assembly.

A Normal Department was also established for the training of teachers for the public schools of the State.

The Register shows no division of classes, and it is impossible to ascertain from it any facts as to the number of students who take any particular study.

There are 14 courses of study. In that of "Military Art and Science," "Civil, Mechanical and Mining Engineering; Military Engineering; and Drawing," are included.

In the Normal Department, Drawing is a required study in each of the three years of this course. The 14th course is that of "Practical Mechanics," under Professor King.

Instruction in Practical Mechanics includes such elementary practice in the workshop as will enable the student to apply the principles of experimental physics taught in the class room, and familiarize him with the use of tools, machinery, and mechanical processes. The course of instruction is based on what is known as the Russian System, now generally adopted in the Agricultural and Mechanical Colleges of this country. It embraces mechanical drawing, the study and care of tools, work in wood and metals at the bench, the lathe, and the forge. This department is under the care of one of the most skillful of practical mechanics.

The following statement of the condition of the college, and of its development, since severed from the University, is taken from the Annual Register for 1881–'82.

The collegiate year of 1881–'82 closes with a larger matriculation than any year which has preceded. The increase over the matriculation list of the year 1880–'81 is no less than thirty-six per cent. Since the severance of the connection with Kentucky University, which took place four years ago, the growth of the College in patronage and public confidence has been uninterrupted, as the following figures will show;

Total number of matriculates 1877–'78 (last year of connection with Kentucky University)	78
Total number of matriculates:	
1878–'79	118
1879–'80	137
1880–'81	234
1881–'82	321

The latest Annual Register* at hand has as a frontispiece an attractive view of the college buildings.

LOCATION.

The Agricultural and Mechanical College of Kentucky is established on the old City Park grounds of the city of Lexington, given to the Commonwealth for this purpose. The site is elevated, and commands a good view of the city and surrounding country. A new College building has been erected, containing commodious chapel, society rooms, lecture and recitation rooms sufficient for the accommodation of 600 students. Two large and well ventilated dormitories have also been built, with rooms for one hundred and forty students, for the use of the appointees sent by the Legislative Representative Districts of the State to the *agricultural, engineering, scientific or classical* departments of the College, and containing suitable dining-rooms, kitchens and servants' rooms.

Lexington is now the most important railroad center in Kentucky, being in immediate communication with Louisville, Cincinnati, Maysville, Chattanooga, and with more than seventy counties in the Commonwealth. The long established reputation of the city for refinement and culture renders it attractive as a seat of learning, and the large body of fertile country adjacent, known as the "Blue Grass Region," with its splendid stock farms, affords unsurpassed advantages to the student of agriculture who desires to make himself familiar with the best breeds of horses, cattle, sheep and swine in America.

*Annual Register of the State College of Kentucky. Lexington, Kentucky. Matriculates for the college year 1891–'92. Session begins Wednesday, September 14, 1892. The Will S. Marshall, Printing Co. Pp. 87.

The following Degrees are given by this College.

The degrees conferred are Bachelor of Agriculture (B. Agr.), Bachelor of Science (B. S.), Bachelor of Arts (B. A.), Bachelor of Pedagogy (Ped. B.), Civil Engineering (C. E.), Mechanical Engineering (M. E.), Master of Agriculture (M. Agr.), Master of Science (M. S.), Master of Arts (M. A.).

The necessary expenses are very small. Those for the "county appointees" living in the dormitory and messing at a "commons" table, are given as $125.50, for the scholastic year. For students paying tuition, and boarding in private families, the estimate is $173.00 to 192.00.

Several full page illustrations give views of the Mechanical Hall,—the building containing the work shops, etc.—and, also, show well equipped machine and wood working shops.

The following are the several courses of study, which are carried on under the direction of separate faculties.

Agricultural, Scientific, Biological, Civil Engineering, Classical, Mechanical Engineering, Veterinary, Normal School, and Academic courses of study have been established under the instruction and management of the Faculties which follow. The courses of study required for the degrees conferred, with their distribution and hours of recitation, are also exhibited therewith.

Tables are given of recitations and schedules of studies through the full courses. The following extracts from the course in Agriculture, shows the technical industrial training given the young farmers, and also the opportunities offered for compensated employment.

WOOD WORKING AND FORGING.

The course in Shop Work is intended to give young men such a training in the use of carpenter's bench tools, and in iron and steel forging, that they will be able to make any ordinary repairs about a farm, in either iron or wood.

STUDENT LABOR.—Students holding certificates as county appointees have the privilege of working for pay upon the college farm and gardens during the afternoons and Saturdays, when such labor does not interfere with instructions in class room and field. In the opportunities for compensated labor upon the grounds preference will be given to the students of the agricultural course, and their hours for study will be so arranged as to aid them as far as practicable in their efforts for self-support. It cannot be expected, however, that the average student, having only unskilled labor to offer, will be able to pay the entire expenses of his college course by this means. The maximum compensation for ordinary labor is eight cents per hour; for skilled labor ten cents may, by special contract, be paid."

There is also, a special two years course in Agriculture, for the benefit of farmers' sons who cannot take the full course of four years. To be admitted to this course the student must be at least 18 years of age.

The following is the full course in Mechanical Engineering.

DEPARTMENT OF MECHANICAL ENGINEERING.

The training given in this school, both practical and theoretical, is intended to prepare young men for positions of responsibility and trust in the Commercial and Mechanical Engineering world. The practical work extends over a period of two

years and includes the most important principles and operations in bench work in wood, wood turning, pattern making, foundry work, iron and steel forging, and hand and machine work in metal.

The theoretical work during the first two years consists of a thorough training in English, German, Chemistry, Mathematics, Physics, and Drawing, and during the last two years, the fundamental principles of boiler machine and engine design are taken up. By a careful solution of practical problems, the student becomes familiar with the process carried on by operators and designers of successful machine plants.

The course of study in Mechanical Engineering extending over a period of four years leads to the Degree B. M. E. (Bachelor of Mechanical Engineering). The advanced Degree of M. E. (Mechanical Engineer) may be obtained by resident students in one year after taking the degree of B. M. E. from the State College of Kentucky or any other institution of equal requirements, having successfully carried on work laid down, passed a satisfactory examination, and presented an acceptable thesis. Advanced degree may also be taken in three years after obtaining the Degree B. M. E., provided the student has been engaged during the period of three years in practical engineering works, passes a satisfactory examination at the College and presents an acceptable thesis.

FRESHMAN YEAR.

Technical Instruction.

Twenty-six weeks, three hours a week.

(a) Recitations on the forms of wood working tools, and the cutting and peculiarities of timber.

(b) Lectures on the operation of the various forms of wood working machinery.

(c) Lectures on Pattern making, Molding and Casting.

Mechanical Drawing.

Twenty-six weeks, six hours a week, and ten weeks, ten hours a week.

This drawing includes free hand sketches, drawing from copies and model, using parts of machines in the mechanical laboratories as models.

Shop Work.

Thirty-six weeks, twelve hours a week.

(a), Bench work in wood, including exercises in the following operations; planing, sawing, rabbeting, plowing, notching, splicing, mortising, tenoning, dovetailing, framing, paneling, and general use of carpenter's tools.

(b), Wood turning, involving the various principles of lathe work in wood.

(c), Pattern making, which gives the student discipline in the construction of patterns for foundry work.

(d), Foundry work, including the various operations of molding core making, and the melting of iron and brass.

English, thirty-six weeks, five hours per week; *German*, thirty-six weeks, five hours per week; *Algebra*, seventeen weeks, five hours per week; *Geometry*, nine teen weeks, five hours per week.

SOPHOMORE YEAR.

Technical Instruction.

Sixteen weeks, one hour per week.

(a). Lectures on the handling of iron and steel in forging, and the methods of tempering and annealing steel

(b). Lectures on modern machine shop practice.

Mechanical Drawing.

Sixteen weeks, four hours per week; twenty weeks, five hours per week.
(a). Drawing the parts of machines and complete machines to scale.
(b). Exercise in tinting and shading.

Shop Work.

Thirty-six weeks, twelve hours per week.
(a). Exercise in iron and steel forging.
(b). Exercise in vise work in metal.
(c). General machine work, including screw cutting, drilling, planing and the milling of iron, brass, and steel.

Descriptive Geometry, seventeen weeks, five hours per week; *Physics*, nineteen weeks, five hours per week; *Chemistry*, seventeen weeks, five hours per week; *Geometry*, seventeen weeks, five hours per week; *Trigonometry*, nineteen weeks, five hours per week; *Analytical Geometry*, nineteen weeks, five hours per week.

JUNIOR YEAR.

Kinematics.

Seventeen weeks, five hours per week. Under this head are studied the velocity ratios in various motions, construction of gears, cams, quick return motions, straight line motions, epicyclic trains, parallel motions, and the manner of designing trains of mechanism.

Mechanical Drawing.

Thirty-six weeks, ten hours per week. The work done during the year consists in the design of machines to do certain specific work, and the making of detail drawings of machines used in actual construction in the laboratories.

Metallurgy.

Nineteen weeks, three hours per week. The above includes the study of fuels and refractory substance, and the processes employed in puddling iron and making steel.

Chemical Laboratory, thirty-six weeks, five hours per week; *Calculus*, Seventeen weeks, five hours per week; *Physics*, seventeen weeks, five hours per week; *Analytical Mechanics*, ten weeks, five hours per week: *Strengths of Materials*, nine weeks, five hours per week.

SENIOR YEAR.

Thermodynamics.

Twenty-six weeks, six hours per week. This work consists of a study of the laws of thermodynamics, thermal capacities and the application of thermodynamics to the seam engine.

Steam Boilers.

Seventeen weeks, five hours per week. A study of the various commercial steam boilers, consumption of fuel, incrustation, determining the horse power of boilers, boiler tests, the design of boilers for efficiency and economy and the methods of power transmission.

Valve Gearing.

Seventeen weeks, five hours per week. The study of various forms of standard engine valves and methods of designing.

Mechanical Drawing.

Seventeen weeks, ten hours per week. This work consists in working out practical designs of boilers and steam engine valves.

Engine and Machine Design.

Fifteen weeks. five hours per week. A study of the modern methods of designing engines and machines for strength as well as motion.

Experimental Engineering.

Fifteen weeks, ten hours per week. Includes a study of the Indicator, making engine, boiler, belt and materials of construction tests.

Mental Philosophy, seventeen weeks, five hours per week; *Political Economy*, fifteen weeks, five hours per week; *Thesis Work*, sixteen weeks, five hours per week.

Every student before he attains the degree of B. M. E. must present a satisfactory thesis on some new design of a machine, or an original investigation of some old machine.

The greater part of the second term of the Senior Year is given to the preparing of this thesis. The subjects for thesis are assigned to students by the professor of Mechanical Engineering, and the completed theses are kept on file with the college records, that they may serve as a reference for future investigation."

The facilities for carrying on this thorough course are thus set forth.

A DESCRIPTION OF THE MECHANICAL HALL AND A STATEMENT OF ITS EQUIPMENT.

The Building.—Mechanical Hall is built of pressed brick and stone and finished in yellow pine. It contains the following rooms: Recitation room 34′×25′, Recitation Room 25′×23′, Library and Exhibition Room 25′×23′, Office 10′×12′, Drawing Room 34′×35′, Engine Room, 20′×30′, Tool Room 30′×6′, Wash Room 30′×10′, Boiler House 27′×27′, Wood Shop 80′×34′, Machine Shop 42′×35′, Blacksmith Shop 35′×35′, and Foundry 35′×37′.

Recitation Room.—The Recitation Rooms are supplied with all the modern conveniences for efficient class room work.

Drawing Room.—The Drawing Room contains drawing tables, drawing boards, curves, scales, tee squares, and other special drawing apparatus to accommodate thirty students.

Engine Room.—The Engine Room contains a 10 inch by 24 inch Hamilton Corliss noncondensing engine and an 8.5 Kilowatt Edison compound dynamo with ampere meter, resistance box and volt meter so that the dynamo may be used for experimental purposes.

Wood Shop.—The Wood Shop contains twenty benches, with complete set of wood-working tools, thirteen wood turning lathes, each with complete set of turning chisels, band sawing machine, universal wood worker, fret saw, and grindstone.

Foundry.—The Foundry contains a thirty inch Cupola furnace with a capacity of a ton of metal per hour, brass furnace, twelve complete sets of moulders tools, twelve benches, also ladles, clamps, core rooms, core oven, pattern rack, and the tools contained in a practical foundry.

Blacksmith.—The Blacksmith Shop contains a ten inch steel pressure blower, twelve forges, twelve anvils, three Blacksmith vises, an emery grinder, and twelve complete sets of blacksmith tools for carrying on all kinds of iron and steel forging.

Machine Shop.—The Machine Shop contains six lathes, one milling machine, one self-feed drill, one planer one shaper, one tool grinder, one emery grinder, one miller grinder, and twelve iron vises, and benches for vise work in metal.

Tool Room.—The Tool Room is supplied with a fine assortment of superior tools for work in iron, steel, brass and wood, and contains such stock and supplies as may be used in constructions in the Mechanical Laboratories named above.

Wash Room.—The Wash Room contains lockers for sixty-five students and is supplied with marble basins, and closets.

Boiler House.—The Boiler House contains a fifty-one horse power Babcock and Wilcox water-tube boiler and a Dean Bro's No. 3 Steam pump.

The building is heated by steam and lighted by 130 incandescent and four arc lamps.

The following is the list of the Faculty in charge of "The Mechanical Engineering Course."

FACULTY OF INSTRUCTION.

J. K. Patterson, Ph. D., President, Professor of History and Metaphysics.
F. Paul Anderson, B. M. E., Professor of Mechanical Engineering.
J. P. Nelson, C. E. M. E., Professor of Physics.
Jas. G. White, A. M., Professor of Mathematics and Astronomy.
John Shackleford, A. M., Professor of English Language and Literature.
J. H. Kastle, Ph. D., Professor of Chemistry.
F. M. Helveti, A. M., Professor of French and German Languages and Literature.
———,* Professor of Geology and Paleontology.
C. D. Clay, 1st Lieut. U. S. A., Professor of Military Science.

From the alphabetical lists it appears that the total number of students in all the Departments of the College for the year 1891–'92, was 642; of whom 186 were girls. Of these 391, of whom 95 were girls, were in the college proper; 53, of whom 31 were girls, were in the Summer Normal School of 1891; 198, of whom 60 were girls, were in the Commercial Department.—There were eleven "Graduates of 1891–'92;" one of these was a girl.

The Register shows no classes, nor does it show what studies each student is pursuing; nor, whether they are in the Academy, the Normal School, or the Colleges.

There is a State Board of twelve Trustees, the terms of office of four of whom expire at the end of each two years. The Governor of the State is *ex officio* chairman of the Board.—Governor John Young Brown was chairman in 1891–'92, and Col. Hart Gibson, of Lexington, was Secretary of the Board. The "Faculty of Instruction," comprises 24 Professors and Assistants, and one Stenographer. James K. Patterson, PH. D., F. S. A., is the President.

THE LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE, BATON ROUGE, PA.

"The Louisiana State University and Agricultural and Mechanical College" had its origin in certain grants of land made by the United States Government in 1806, 1811, and 1827, "for the use of

* To be appointed.

a seminary of learning." In 1855 the Legislature founded the "Louisiana State Seminary of Learning and Military Academy," locating it three miles from Alexandria in the parish of Rapides. The Institution was opened January 2nd, 1860, with Col. William Tecumseh Sherman, (later, General-in-Chief, United States Army) as Superintendent."

This institution, twice closed in consequence of the war, had its buildings accidentally burned October 15th, 1869, and in November of the same year was transferred to Baton Rouge, where it has since remained.

The Louisiana State Agricultural and Mechanical College was established by an act of the Legislature, approved April 7th, 1874, to carry out the United States Act of 1862, granting lands for this purpose.

The Chalmette Battle Ground, was given it as a site, but the college was

opened in New Orleans June 1st, 1874, and remained there till its merger with the University.

On the 2nd of January, 1877, the act, as passed by the Legislature in 1876, uniting the State University and the Agricultural and Mechanical College, and locating the same temporarily at Baton Rouge, became a law; and it was duly promulgated June 1st, 1877.

The new institution, consolidated from the two separate State institutions, under its present name and legal title, opened its first session October 5th, 1877, under charge of Col. David F. Boyd, the former Superintendent of the Military Academy.

Col. William Preston Johnston, LL. D., formerly a Professor in Washington and Lee University, Va., was elected President, October 4th, 1880, and in 1880–'81, the institution was reorganized. The above historical sketch is abridged from that given in the Report of the Board of Supervisors, under date of May 6th, 1882,* from which the following account of the College courses, and the statements of the Board on the general topic of similar institutions are taken.

LOCATION.

The Louisiana State University and Agricultural and Mechanical College is located at Baton Rouge, on the east bank of the Mississippi, where the first high land is met above the mouth of the river. It is accounted one of the healthiest spots in the State. It has a mild winter climate, well suited to students of delicate constitution from more northern States, while the summer heats are tempered by breezes from the Gulf and Lake Pontchartrain. The University building is a superb structure. The large rooms, lofty ceilings, and wide verandahs, half a mile in length under a continuous shelter, make it a healthful and pleasant residence for its students. Great attention is paid to sanitary arrangements, water supply, drainage, disinfection, etc.

* Report of the Board of Supervisors of the Louisiana State University and Agricultural and Mechanical College, to the General Assembly of the State of Louisiana. State Printer, Baton Rouge, 1882,–Pp. 120.

The optional system having proved a failure after a trial of seven years, fixed courses of study and a fixed standard for degrees were established in the reorganization. A preparatory department for both courses is attached to the University, to which students are admitted on passing a satisfactory examination in certain prescribed studies, and from which they enter the University, and college classes, on passing satisfactory examinations.

INSTRUCTION AND DEGREES.

There are two University Courses, a Classical, and a Scientific, of four years each; and an Agricultural, and a Mechanical Course, of two years each. These have corresponding degrees: Bachelor of Arts, Bachelor of Science, Graduate in Agriculture and Graduate in Mechanics. The degree of Master of Arts will be given to Bachelors who have resided one year or more at the University and passed a satisfactory examination on a prescribed course of study, or two years elsewhere on the same terms. Students can choose among those named the course they will pursue, with the approval of their parents. Special or irregular students will be received with the permission of the President, when their requirements do not conflict with the regular routine.

In the University course, which is otherwise the usual classical college course, Drawing is taught to a "sufficient" extent.

AGRICULTURAL AND MECHANICAL COURSES.

These courses are accomplished in two years, and embrace just half the amount of study required to take a degree in the University proper. Our effort is to give the education contemplated in the Federal grant to the College; that is to say, one both "liberal and practical." It is intended especially for those who expect to devote themselves to the industrial arts, or to agriculture, in Louisiana; and affords *an opportunity nowhere else to be had*, for a youth to learn the things which are most important in fitting him intelligently to cultivate and handle the staple crops of the State; sugar, cotton and rice. With these are joined, instruction in horticulture and the domestic arts, and in a few of those branches of general and special culture which help to make the home of the planter or mechanic comfortable, respectable and contented. Other institutions may excel in their own particular lines of education, but we assume as the special province of our college to prepare young men for the life of planter, or plantation mechanic. No expensive laboratories, or costly farms are required to illustrate our theoretical teaching. The neighboring cotton fields, sugar-houses, oil mills, gins, etc., etc., conducted practically and for profit, are open to the study and inspection of the student, and, under competent direction and instruction, will complete the labors of the lecture room.

In the Mechanical Course there is a full course of mechanical instruction, theoretical and practical. Mathematics is carried through Analytical and Descriptive Geometry, with a short course of Engineering. A full course of Drawing is given, and also of French, and a good course of English and Chemistry and Physics, including the Theory of the Steam Engine. There are also moderate, but sufficient, courses in Social and Industrial History, English Literature, Political Economy and Ethics.

In the spring of 1881 a neat workshop was erected at the University, which is now supplied with carpenter's benches and tools, three turning lathes, with the necessary belting and shafting, a four horse power Baxter portable steam engine, a jig saw and other machinery, grind stones and some blacksmith tools, etc., etc.

In this building are conducted various exercises in wood-working, embracing carpentry, wood turning, and pattern making; and as the occasion requires, the building is to be enlarged by the addition of rooms, which will be supplied by the necessary appliances for practical instruction in the manipulation of iron and other metals.

As far as practicable, the course given in the workshop is in accordance with the plan adopted by the Stevens Institute of Mechanical Engineering, at Hoboken, at New Jersey. The initial step in this course is to supply each cadet with a few of the most ordinary carpenter's tools and have their different uses explained, as well as the methods of sharpening and otherwise putting them in order; after which, the tools being expressly put out of order, the beginner undertakes the work of sharpening and re-adjusting them. It being a matter of utmost importance for a mechanic to keep his tools in perfect order at all times, considerable attention is given to such exercises as will aid the learner in overcoming the many difficulties he encounters in this regard, and from time to time he is called upon to give practical evidence of his proficiency respecting the case in question.

Without entering into details, it will suffice, for the present, to say that the course in wood working, which is first given, and which embraces the period of one year, is arranged in a systematic and regularly progressive manner, beginning with instruction in sharpening tools and the use of the saw and jack plane, and thence leading step by step to the higher grades of carpentry, such as house, bridge and roof framing, cabinet and pattern making. In conducting his exercises, the instructor, as aids in arranging and systematizing his work, makes use of the most approved text-books bearing on the subject, among which are Tredgold's Carpentry, Shelly on Workshop Appliances and Holly on Saw Filing. An important feature connected with the course is the instruction in wood turning. The lathes are run by steam power and contribute vastly towards imparting that easy and free motion to the hand so necessary to the accomplished mechanic. Wood turning in its variety of forms is not only a beautiful art, but to many it is a source of great interest and amusement.

Special attention is paid to Drawing, beginning with free hand exercises in the preparatory department. By successive steps the learner is taught to use instruments in a neat and effective manner, and, finally, is instructed with especial care in Architectural and Mechanical Drawing.

This course given in two years, is not proposed as a full course for Mechanical or Civil Engineers, but it will give the student a sound and thorough ground work on which to build such engineering course, and is in itself more than sufficient for the ordinary requirements of first-class planters and mechanics. On those who complete it, is conferred the title of "Graduate in Mechanics."

The indisposition to a purely agricultural course is apparent in this institution as elsewhere; on this fact, the Board remark.

For reasons not necessary to discuss here the mechanical studies seem more attractive to students than an agricultural course. At a sister institution, the Texas Agricultural and Mechanical College, where they have a large farm and many appliances, there are 48 agricultural and 132 mechanical students. A similar experience is obtained elsewhere.

At present there are scarcely any students in the University looking to a course distinctively agricultural, as differentiated from a mechanical course. All the preliminary steps to such an agricultural course have been taken in offering and teaching the studies laid down in the prospectus, and in a course of Natural Science. taught by Professor McCulloch, adapted to the advancement of our students, and intended to stimulate curiosity and to invite further pursuit of agricultural branches. The most practical development of this department will be the appointment of a

Professor of Agriculture, zealous and fully equipped for his work in theory and practice, and such an appointment will be made whenever the means of the University will justify it.

WISDOM OF CONGRESS IN LEAVING THE EDUCATIONAL METHODS OF THE LAND GRANT COLLEGES TO THE DISCRETION OF THE STATE LEGISLATURES.

We cannot hope to satisfy the desires or expectations of everybody in regard to an Agricultural College. The theories and projects in regard to such an institution are vague and manifold in the popular mind. Every conceivable form of educational institution, from a manual labor school for rural apprentices to a polytechnic industrial university, requiring an endowment equal to Harvard's or Yale's, is sketched out as the only true and genuine pattern for such a college, and as required by the Federal grant. This is all a mistake. The grant is very general in its terms, leaving to each State to determine the form in which it should be applied. In Connecticut it was employed to endow two scientific chairs in Yale College; in New York, to give a foundation to Cornell University, which proposes to teach everything. In some States it has been divided between an agricultural school and a mechanical school. In others they are united. In a word, the law has resulted in the widest diversity of development among the institutions benefited by it. So far from being a misfortune, this has been one of its greatest blessings. To suppose otherwise is to assume that final results have been reached in the science of education, and one pattern established for all possible conditions of society. We have not yet reached this point of illumination. Doubtless many mistakes have been made, but none which could compare with the adoption of a uniform plan for all the agricultural and mechanical colleges.

President Mills, of the Ontario (Canada) Agricultural College, has devoted a good deal of time and attention to the statistics of education. In a recent report of his he states these interesting facts:

"In the German Empire there are 156 agricultural farm schools and agricultural middle schools, under the control of the Government, 42 of which are devoted to specialties such as vine and grape culture, horticulture, bee-keeping, etc. There are 6 agricultural colleges with farms of from 800 to 1,500 acres, and with extensive laboratories and appliances, and complete curriculums in the theoretical branches. After completing his studies in such a college, and successfully working as a farmer, the agricultural department of 9 great universities are open to the student. Besides these schools and colleges are 43 experimental stations; and the cost of all—schools, colleges and experimental stations—is borne by the State.

"In 1876 there were 39 agricultural colleges in the United States—473 professors and 4211 students. The average salary of a professor was $200, and of the presidents $3200; many who were also presidents of universities receiving from $4000 to $6000. The average interest paid each college from the Agricultural Fund was about $13,500."

The Commissioner of Education reports that in 1879 there were 45 such colleges, with 3957 students and 1577 preparatory students.

It is evident from these facts that there is no panacea for ignorance of agriculture. The roads to knowledge are many, and we must take that directly before us. We must do what we can; not what we would. The General Assembly may rest assured that whatever appropriations it can constitutionally and conscientiously vote for the purposes of agricultural education will be cautiously and judiciously expended by the Board of Supervisors, under a full conviction of the vast importance of agricultural and mechanical education to the young men of Louisiana."

After describing in detail the progress of the past year and the changes recommended by the President, all of which are of great interest as showing originality in devising plans adapted to the cir-

cumstances of that community, the Board conclude with these pregnant remarks on the immediate needs of education.

"In Europe a University is presumed to contain Faculties of Art, Medicine, Law and Theology. In our American modes of speech and thought, it has come to mean merely one of our higher institutions of learning. When a State lends the sanction of its authority to the establishment of such an institution it becomes it to see that neither the name nor the purpose of a University is degraded and robbed of its significance. As now located it is not desirable that the University should be embarrassed by a union with a Law or Medical college. But there is no reason why its instruction should not be so directed and adjusted as to give due preparation for the excellent Law and Medical Schools in New Orleans, thus affording within the limits of the State the means of a rounded Academic and Professional Education exactly adapted to the wants of the citizens.

With the countenance and support of the State authorities and of the good people of this commonwealth who have faith in its high destiny, we hope to build up a University where the highest education will be within reach of its sons, and an Agricultural and Mechanical College where a liberal and practical education will be afforded to those whose purpose is the pursuit of an industrial career, whether on the farm or in the workshop. To accomplish so desirable an end we rely upon the patriotic co-operation of the Executive and Legislative Departments.

A number of schemes are proposed for the removal of illiteracy in the South by the Federal Government. Undoubtedly, in view of all the facts, such aid should be given liberally. But we cannot afford to wait. Our boys and girls are growing up in ignorance, while, like blind Belisarius, Louisiana stands at the gate with outstretched palm, crying: "Give me an obolus."

If we are poor, so much the more necessary to nerve ourselves to extraordinary exertions. Each community must make a strenuous, it may be a painful effort, to supply its own wants—to supplement the fund which it first pays into the State Treasury, and then in part draws out again.

Each community must see to it that as much money is raised as can be for the education of the young, that the teachers are competent for their positions; that they are paid a fair living and not starvation wages; that the school is kept enough months in the year to give the children all the benefit possible—nine months instead of five or six—and that the education of our children becomes a live issue in the land, as much the business of a man, as food and clothing for them.

If our people once awaken to the idea that knowledge—the food and raiment of the immortal mind—is as much a necessity for nurture as the things that perish, we may look forward to the regeneration hoped for and prayed for, if not worked for, in the life of the State. Then will aspiration and endeavor, with mutually toiling hands, broaden the foundation of the common school, and raise upon this base the tall columns which fitly represent the High Schools, and crown them with the University as with architrave, frieze and cornice, even as the Athenians reared to the Goddess of Wisdom the Parthenon, which surmounted their Acropolis."

The catalogue for the year ending July 4th, 1882, shows an attendance of 159 Cadets; an increase of 90 over the attendance of the previous year.

The latest catalogue* at hand is embellished with eight full page "process" copies of photographic views of the buildings and grounds of the college. These show typical, low, roomy southern buildings,

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*Catalogue of the Louisiana State University and Agricultural and Mechanical College, Baton Rouge, La. for 1890-'91. Printed at the Truth Office, Baton Rouge. 1891. Pp. 50.

with their characteristic deep, shaded galleries, which convey such an impression of comfort and coolness, in a climate where convenient retreats from the glare of the summer sun are a necessity. The view of the tree shaded avenue leading from the City to the "Barracks," and that showing the broad current of the mighty Mississippi sweeping by, are each very striking. The situation and the buildings as seen in these views are most attractive. They are thus described in the catalogue:

THE SITE AND APPURTENANCES.

The site, which forms the north boundary of the city of Baton Rouge, has a front of 1500 feet overlooking the Mississippi River, and extends back to a depth of 6600 feet, containing about 200 acres. The surface is high and generally level, but sufficiently rolling to afford good natural drainage. It is believed to be one of the healthiest localities in the South.

The grounds are covered almost perpetually with rich green grass, and shaded by majestic old oaks, which, with the massive buildings, conspire to render it a delightful and attractive home for students and professors.

THE BARRACKS.

The barracks are composed of four brick buildings, each 40 feet by 180 feet, and two stories high, with broad galleries, in front and rear, supported by large circular brick columns. These buildings occupy four of the sides of a regular pentagon, the fifth or unoccupied side being next and adjacent to the river. The rooms on the ground floors are used as class rooms, offices, reading rooms, etc., and those on the second floors are lodging and study rooms for cadets. The corps of cadets is organized into a battalion of four companies, and each company occupies a building. Each room has a fire place, and seldom more than three cadets occupy the same room.

The several buildings occupied by the various departments are each described; of these the account only of that given to the Mechanical department, will be here quoted.

The following, from the announcement of the purposes of the University gives a general outline of its courses.

OBJECTS OF THE INSTITUTION.

In conformity to its charter, the object of the Institution is to give especial prominence to instruction in those sciences relating to Agriculture and the Mechanic Arts; and at the same time offer to its students opportunities for a literary and general scientific education. In other words we are attempting to build up a University where the highest education will be in reach of the youth of Louisiana, and an Agricultural and Mechanical College where a liberal and practical education will be afforded to those whose purpose is the pursuit of an industrial career.

COURSES OF STUDY.

To compass the aforesaid objects three courses of study have been established, viz: The Agricultural, the Mechanical and Civil Engineering and the Literary. Each of these courses has four classes, viz: The Freshman or *Fourth*, Sophomore or *Third*, Junior or *Second*, and the Senior or First; and though intended to prepare students for different pursuits in life, they are parallel and substantially equivalent in the amount of training and instruction afforded."

An additional course known as the "Latin-Scientific Course," leading to the degree of B. S., has been added; so that the college now offers four full courses of study, each of four years. A preparatory school is attached to the college. Post Graduate instruction is also offered. The following degrees are conferred.

DEGREES.

The degree of Bachelor of Science (B. S.) is conferred upon that cadet who completes successfully either the Course in Agriculture or the Course in Mechanics and Engineering. The Degree of Bachelor of Arts (B. A.) is conferred upon that cadet who completes successfully the Literary Course.

POST-GRADUATE DEGREES.

The degree of Master of Science (M. S.) will be conferred upon Graduate students in the Agricultural Course; the degree of Civil Engineer (C. E.) on graduates in the Course of Mechanics and Engineering; the degree of Master of Arts (M. A.) on graduates in the Literary Course; provided that, in each instance, they comply with the conditions heretofore prescribed.

THESIS.

Every candidate for graduation must write and submit to the professor of English, by the first of June, an original thesis on a subject of immediate relation to his course of study; the subject to be approved by the professor in charge.

The government of the Institution is military, and by the cadet regulations the Professor of Military Science and Tactics is also commandant of cadets.

Once admitted, no cadet is allowed to leave the grounds "except upon permits issued in the regular order." The various parishes of the State, and the City of New Orleans, are entitled to send a certain number of cadets, 75 in all; whose expense to the parish is not to exceed $250 per annum.

These State Cadets are appointed for four years, and are required to teach school, or to follow some mechanical or agricultural pursuit in Louisiana, for two years after graduation.

The following are the courses in which Drawing and Industrial Training enter most largely:

MECHANICS AND DRAWING.

J. H. Randolph, Professor.

The special work of this department embraces a period of three years, beginning with the Freshman year.

In the Freshman year, the subjects of Linear and Projection Drawing, Shades and Shadows, and Isometric and Machine drawing, will be taught, and there will be daily exercises in the shop for a period of four months.

In the Sophomore Class, the subjects of Descriptive Geometry, Carpentry and Architecture will be taken up, with exercises in Architectural and Mechanical Drawing, as well as shop work; exercises in the latter to be given daily for a period of four months.

In the Junior year, instruction will be given in Roads and Bridge Construction, and in Theoretical Mechanics. In connection with the latter will be taught the

Principles of Mechanism, embracing the principles underlying the action and construction of the elementary combination of which all machines are composed. Some attention will be paid to the construction of the steam engine, boiler riveting, uses of the governor, inspirator, and indicator, method of calculating the horse power of an engine, and to the acquisition of other knowledge in connection with the steam engine.

Much attention is paid to drawing in this department, and besides Architectural and Machine Drawing, a short course is given in Topographical Drawing as one of the requisites in the study of Civil Engineering.

MECHANICAL WORKSHOP.

The Mechanical Workshop, which is located about 300 feet east of the Agricultural Hall, consists of a brick building one story high, with a slate roof and is 100 feet long by 30 feet wide, and is fairly equipped for wood work. It is provided with one iron frame saw table, two wood turning lathes, and one scroll saw, all of which are operated by a Watertown eight-horse power portable steam engine. Besides the above are the following machines for foot power: One rip and cross cut saw table, two wood turning lathes, one mortising machine, two scroll sawing machines, one hand tenoning machine, and tools and benches suitable for conducting, to a class of about sixteen at a time, the principal elementary exercises in wood work. With a view of equipping for exercises in blacksmithing, a few tools in that line have been purchased, and it is proposed to give this branch a practical turn at an early day.

The Mechanical Department is also provided with three working models of steam engines, two of which are vertical and one the oscillating type, all of which are provided with different methods for admitting steam into the cylinder ports, thus furnishing ready means for practically illustrating how steam may be used as a motive power.

This department is indebted to the generosity of Mr. Thos. J. Kernan, of the city of Baton Rouge, for one of the small vertical steam engines, and one of the foot power lathes alluded to.

PHYSICS AND ENGINEERING.

W. D. Taylor, Professor.

The student's work on this subject begins in the second half year of the Sophomore Class, and he is required to possess a knowledge of Linear and Projection Drawing and of Algebra, Geometry, and Trigonometry. In this class he is taught Practical Mensuration, Field Surveying, Levelling and Plain Map Drawing, and the use and adjustment of level, compass and transit. Practical illustration in the field will be given of each subject.

The Junior year is devoted to the theory of Plain, Reversed, Compound, Transition and Parabolic Curves as applied to the *Location* of Common Roads and Railroads; The Computation of Earthworks, Methods of Profiling, Laying Grades, Laying off Work, and Compensating for Curvature as applied to the Construction of Roads, Railroads, Dams and Levees, Topographical Surveying, Map and Section Drawing, with practical work on subjects taught.

When the student enters the Senior Class he is supposed to have a knowledge of Perspective, Orthographic and Isometric Drawing, Elementary Analytical Geometry and Calculus. In this class the mechanical uses and properties of the different building materials and their desirability in special locations as compared with one another are taught; also the methods of the preservation of materials, the methods of securing foundations, of the construction of bridges, roofs, canals, locks, dams,

docks, piers, masonry and their adaptability to special locations. The student is taught both graphically and mathematically the strength of materials, and the calculation of the strains on different bridges, roofs, and trusses and the economic proportioning of structures. Structural drawings of the subjects discussed are required of the students from time to time.

The advanced course in Physics extends throughout the whole of the Senior year, and consists in instruction by means of both lectures and recitations, supplemented by experimental illustration of the leading principles of the subject. Special attention is given to instruction in those divisions of the subject, a knowledge of which will prove of most practical utility to the student."

Col. William Preston Johnston, was called from the Presidency at the close of the year 1882, to assume the position of President of the newly founded Tulane University, in the City of New Orleans, in January 1883.

The catalogue for the year 1890–'91, gives a list of 179 cadets in attendance; of whom 4 are "special students." The classes are not indicated.

The Faculty consists of 20 Professors and Assistants. There is a Board of 17 Supervisors; of whom the Governor of the State, The Superintendent of Public Education, and the President of the University, are, "*Ex-Officio*," members.

Col. J. W. Nicholson, Professor of Mathematics, was the President in 1891.

CHAPTER X.

UNITED STATES LAND GRANT COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS—Continued.

ANALYSIS OF CHAPTER.

MAINE STATE COLLEGE.

The State College of Agriculture and The Mechanic Arts of Maine, is situated at Orono, which place is distant nine miles from the city of Bangor.

The course of study entitling to a degree is for four years. There are five full courses of Instruction, viz: In Agriculture, Civil Engineering, Mechanical Engineering, Chemistry, and in Science and Literature. The studies in all the courses are essentially the same for the first two years.

By a recent law of the State, fees for tuition, which had before been free, were charged; with the effect of quite a reduction of numbers in the entering Freshman class.

The tuition is fixed at $30 per year. Free-hand and Mechanical Drawing are taught all through Sophomore vear.

DRAWING.

The work in drawing commences with a course in Free Hand and Elementary Mechanical Drawing, extending through the Sophomore year. The first term of the Junior year the student gives the time not required for shop-work to line shading and drawing from dimensions taken by him from actual machines.

The second term of this year is devoted to isometric and cabinet projection and perspective. The time for drawing in the Senior year is given to drawing from dimensions, from locomotive details, and to designs by students, of machine, engines, &c.

In the courses in Civil and Mechanical Engineering, Drawing is taught, varying a little in the two courses, one taking "field work and Topography and Rail-road work," while the other takes "shop work and Machine Drawing,"—otherwise the Drawing courses are alike.

The catalogue for 1881–82, shows an attendance of ninety students.

The following account of the instruction in Mechanics in this college is from Professor Runkle's paper on "The Manual Element in Education," in the 45th Annual Report of the Mass. Board of Education, 1880–'81.

MECHANIC ART INSTRUCTION IN THE STATE COLLEGE, ORONO, MAINE.

President Fernald says, "This instruction was introduced into our Department of Mechanics four years ago, and has been prosecuted with constant interest and success. We have established, in shops of a temporary character, two courses,—vise-work and forging, carrying out the system much as is done in the Massachusetts Institute of Technology. Pupils take to the work with zeal, and their progress in it has been in the highest degree satisfactory. The number of lessons in vise-work is forty-two, of three hours each, five per week. The course includes twenty-three different pieces. Sometimes the class has been divided, each section working on alternate days. The course in forging includes twenty-eight pieces, with lessons in length the same as in vise-work, and about the same number. At the earliest date possible we design to extend the system in our college. We do not regard the work as interfering with other studies, but as constituting a part of a carefully devised scheme, or course of study, in which it is entitled to the time required. It is scarcely possible that manual skill can be acquired in accordance with a definite and progressive plan of work, in which the principles and processes are made prominent, without at the same time giving a certain amount of intellectual discipline, an amount by no means unimportant."

The catalogue for 1891–'92*, follows the prevailing fashion in giving nine full pages of views of the exterior and interior of its build-

*Catalogue of the State College of Agriculture and the Mechanic Arts. Orono, Maine, 1891–'92. Augusta: Burleigh & Flynt, Printers to the State. 1892. Pp. 65.

ings and shops. Of these the plat of the campus, the general view of the buildings, and that of the dress parade of the "Coburn Cadets," are of especial interest. The attention paid to the military features of these U. S. Land Grant colleges is suggestive.

The Republic is seen to be training soldiers, as well as farmers and mechanics. In some States, as, for instance in Louisiana, this feature seems to be more prominent than in others. Training in Agriculture evidently receives careful attention in this college of Maine.

The situation of the college is thus described:

"LOCATION.

The college has a pleasant and healthful location, between the villages of Orono and Stillwater, about a mile from each. Stillwater river, a tributary of the Penobscot, flows in front of the buildings, forming the western boundary of the college farm, and adding much to the beauty of the surrounding scenery.

The Maine Central Railroad, over which trains pass many times each day, has a station at the village of Orono. The college is within nine miles of the city of Bangor, and is consequently easily accessible from all parts of the State.

FARM AND BUILDINGS.

The college farm contains three hundred and seventy acres of land, of fair natural productiveness, and of sufficient diversity of soil, to adapt it to the experimental purposes of the institution."

There are nine principal buildings. The Dormitory buildings offer accommodations for 125 students. The equipment in the way of buildings and apparatus seems wholly adequate.

"The shop is amply equipped for instruction in the working of wood and iron, including the processes of carpentry, wood turning, filing, forging, lathe work, and the casting of metals.

* * * * * * *

DESIGN OF THE INSTITUTION.

It is the design of the Maine State College of Agriculture and the Mechanic Arts to give, at a moderate cost, the advantages of a thorough, liberal and practical education. It seeks to do this by means of approved methods of instruction, and especially by making prominent the system of practically applying in the drawing room, in the laboratory, in the shop, and in the field, the lessons of the class-room. It thus endeavors to make its courses of high practical value.

* * * * * * *

COURSES OF INSTRUCTION.

Five full courses are provided, viz: A course in Agriculture, in Civil Engineering, in Mechanical Engineering, in Chemistry, and in Science and Literature.

The studies of the several courses are essentially common for the first year, and are valuable not only in themselves, but also as furnishing a necessary basis for the more technical studies and the practical instruction of the succeeding years.

* * * * * * *

SPECIAL COURSES.

Students may be received for less time than that required for a full course, and they may select from the studies of any class such branches as they are qualified to

pursue successfully. Students in Special Courses are not entitled to degrees, but may receive certificates of proficiency. Two short courses in Agriculture, definite in form, are also provided; courses involving less time than that required for obtaining a degree.

DEGREES.

The full course in Civil Engineering entitles to the Degree of Bachelor of Civil Engineering; the full course in Mechanical Engineering, to the Degree of Bachelor of Mechanical Engineering; the full course in Agriculture, Chemistry, or Science and Literature, to the Degree of Bachelor of Science.

Three years after graduation, on presentation of a satisfactory thesis with the necessary drawings, and proof of professional work or study, the Bachelors of Civil Engineering may receive the Degree of Civil Engineer; the Bachelors of Mechanical Engineering, the Degree of Mechanical Engineer; the Bachelors of Science, the Degree of Master of Science.

The following is the course in which Drawing and Mechanical Training enter as essential studies.

COURSE IN MECHANICAL ENGINEERING

It is the design of this course to give such a knowledge of Mathematics, Mechanics, Principles of Mechanism, Drawing, and Manual Art as shall enable the student successfully to enter practical life as an engineer, with the same thorough education in subjects required to fit him for the general duties of life as is afforded by the other courses.

The first two years' work is identical with that of the students in Civil Engineering except that carpentry and forge work are taken the second year in place of part of the drawing. In the junior year, the first term is devoted to the geometry of machinery, showing the students how different motions may be obtained independently of the power required. Special attention is here given to the subject of gearing, and a full set of problems worked out, illustrating cases commonly occurring in practice. Instruction is also given by lectures and text-books, on other methods of transmitting motion, as by belts, cams, coupling, and links. Considerable time is given to the study and designing of the various valve and link motions used on the steam engine. During the second term of the junior year, instruction is given in analytical mechanics, and the laws of the strength of materials, the student being required to design machine details in accordance with those laws.

The first part of the first term, senior year, is employed in studying the laws of the expansion of steam and their influence upon the construction of steam engines, the subject being illustrated by experiments on the shop engine, with the aid of an indicator. During the remainder of the term, the students are engaged in designing engines and other machines, and in making detail drawings of the same, such as would be required to work from in the shop.

During the last term, senior year, the study of steam engineering is continued in its application to the construction of steam boilers. In connection with this subject the student is required to design a steam boiler in all its details. The subject of hydraulics is taken up briefly, by text-book work in hydro-mechanics, and the principles applied to the solution of practical problems.

SHOP WORK.

The first term of the sophomore year, two hours of each day are devoted to work in carpentry, special attention being given to accuracy of workmanship. Students are encouraged in every way to make articles of practical use.

During the second term of the same year, the student receives instruction in

forge work, including the welding and tempering of steel. Each student is required to make a set of cold chisels and lathe tools for future use in machine work. A course in machine work during the first term of the junior year gives the student practice in the various methods of shaping and fitting metals by the use of the chisel, hack-saw and file, engine lathe, shaping machine, planer and milling machine. During their second term, the sophomore students in this course take turns in running the shop engine, and are taught the rules of safety and economy in this branch of Engineering. Instruction in wood turning and pattern making is given during the senior year. There is also a course in foundry work in which the student is taught molding and casting. Physical laboratory practice engages the student two afternoons each week throughout the year.

DRAWING.

The work in drawing commences with a course in Free-Hand and Elementary Mechanical Drawing, extending through the freshman year.

The first term of the junior year, the student spends the time allotted to drawing in working out practical problems on the construction of gear teeth, cams, etc., and in elementary practice in line-shading and tinting.

The second term of this year is devoted to isometric projection. During this term the student prepares an original design of some machine, makes working drawings of its details on tracing cloth, and finally prepares copies by the blue-print process. The drafting of the senior year consists of making calculations for designs of engines and boilers, the construction of the necessary working drawings, and making thesis drawings.

The remarks under Course in Civil Engineering, with regard to Astronomy, Mineralogy and Geology, apply also to this course and to them reference is made.

Theses are required of all students as a condition of graduation, and must be on some subject directly connected with Mechanical Engineering.

Students in this course receive the degree of Bachelor of Mechanical Engineering upon graduation, with full degree of Mechanical Engineer three years afterwards upon presentation of a satisfactory thesis and proof of professional work or study."

The number of students is given as follows:

"SUMMARY.

Graduates of 1891	21	Freshmen	23
Seniors	22	Special students	8
Juniors	24		
Sophomores	25	Total	123

It is explained that as the catalogue is made up to December 30th of each year, it records part of two Academic years; so the Graduates of '91 are given; 9 additional students, who have entered since the summary was made, must be added to the total of 123.

The Faculty numbers 19 Professors and Assistants. Merritt C. Fernald, A. M., PH. D., Professor of Mental and Moral Science, is President.

Maryland Agricultural College.

The Maryland Agricultural College, is situated in Prince George County, on the line of the Baltimore and Ohio Rail Road, eight miles north of Washington, D. C. College Hill, on which stand

the principal college buildings, is a beautiful eminence, overlooking wide stretches of country."

The farm contains 286 acres. The courses of study are grouped under seven Departments. The first is that of "Civil Engineering and Astronomy." Drawing is necessarily taught in the course of Civil Engineering. It does not appear from the College Register of 1881 that it is required in any of the other departments.

Much attention is given to a general education and to Agriculture. There was a total attendance of 55 students, in 1881.

A biennial report is made by the Board of Trustees to the Legislature of the State. That for the years 1888–1889,* records the establishment at the college, in accordance with the designation by the Legislature, of an Experimental Station under the provisions of the act of Congress known as the "Hatch Bill," of March 2, 1887, establishing such stations in the several States. This Maryland station "is wholly supported by annual appropriation from the Treasury of the United States and is conducted within its fixed income of $15,000."

The Board on the 9th of March, 1888, when accepting the designation so made by the General Assembly, created a new office to be known as that of "Director of Maryland Agricultural Experiment Station," and then "elected as President of the College and Director of the Experiment Station, Henry E. Alvord, C. E., then Professor of Agriculture in the Massachussetts Agricultural College," at Amherst.

This Maryland College, one of the first of its class to be opened in this country, was founded in 1856, by the public spirit of some five hundred liberal friends of education, mostly citizens of Maryland, who subscribed the sums needed to purchase the property, then an estate of 428 acres, and erect the first buildings.

In accordance with its charter, and regularly from its establishment, the College received an annual donation of six thousand dollars from the State. This was continued, uninterruptedly, for twenty-five years and then was withdrawn for five years, beginning October 1st, 1883.

The report goes on to show the immediate pecuniary needs of the College, owing, in part, to the deterioration of the buildings from lack of needed repairs consequent on this serious shrinking of its resources during these five years.

It appears from the latest catalogue at hand, that the State appropriations have since been resumed; the College has, also, the benefit of the U. S. Land Grant to Maryland, under the law of 1862; and of the Government appropriations for the Experiment Station, made in accordance with the law of 1887.

* Biennial Report of the Board of Trustees of the Maryland Agricultural College, (founded 1856) for the years 1888–1889, rendered to the General Assembly, January, 1890. Annapolis: George T. Melvin, State Printer. 1890. Pp. 62.

The report, states at some length the needs of the Institution, and sets forth the grounds justifying liberal appropriations by the State:

In order to make the benefits of the institution available to as many as possible, the Board has declared tuition and room rent absolutely free to all and reduced the actual living expenses to the lowest point consistent with health and comfort. In June, 1888, the total charge to students for the academic year was reduced to $185, an addition of $60 being made to non-residents of the State. In June, 1889, the rate was still further reduced to $165, and all restrictions as to residence removed. The college is therefore now free to all who are fitted for its work, the receipts from students being merely sufficient to defray their actual living expenses while in attendance. It is safe to say that no educational institution of like grade to this State, or in the neighboring States, offers equal facilities at less cost to the student.
* * *

A concise statement of the college courses is given. It is claimed that the education offered is both practical and theoretical. By inference before the change here recorded the training was more strictly limited to agriculture.

Of the studies more closely related to the topics of this present Report, the following summary is given.

In mathematics the usual college course is taught, but with special reference to practical application; this includes every-day calculations, computations and measurements in ordinary business and country life, and also plane surveying, dividing lands, mapping, road-making, grading, draining, water-works and principles of building and construction. This line of work is accompanied by drawing, free-hand, geometrical and topographical. As required by law military drill occurs four days in the week, the weather permitting, and some theoretical instruction is given in tactics, field operations and military history.

The faculty consists of the president and six resident instructors, four of whom occupy rooms in the college building. Special instructors have been employed as required, and the regular class work has been supplemented during the last two years by valuable courses of lectures by experts and specialists, well-known in their respective lines of investigation.

* * * * * * *

The attendance of students at the college has been steadily, although slowly, increasing, and at the date of writing this report, is larger than at any time for two years. The following table shows the details in this particular:

Attendance of Students in January for Three Years.

Classes.	1888.	1889.	1890.
Senior	7	4	7
Junior	7	8	16
Sophomore	13	12	15
Freshman	7	12	11
Total in College course	34	36	43
Preparatory	8	0	0

The preparatory class was discontinued in the Summer of 1888, as it was found to be incongruous, demoralizing and disproportionately expensive.

* * * * * * *

Compared with similar institutions in other States and some which apparently offer much greater attractions to students, the attendance at the Maryland Agri-

cultural College must be regarded as encouraging. A sub-committee of this Board has lately visited several flourishing Agricultural or "Land Grant" Colleges in neighboring States. Its report of observations presented to the Board is appended, and particular attention is invited to the "Notes on Colleges," from which the following is here appropriately quoted:

"Maryland has more students pursuing the regular course at her Agricultural College than there are at the similar institutions in the great Keystone and Empire States, and compared with the investment, the Maryland College has more students than the Massachusetts College, while, in Maryland, students attend college at a much less cost, both public and private, than in Massachusetts, New York or Pennsylvania."

As military instruction is required at this college as one of the main conditions of its federal endowment, the government of the United States has properly secured to the college, by law, the continuous service of some officer of the regular army, detailed for the purpose from time to time. This makes it convenient and desirable to apply the military system to the discipline of the students while in and about the building. * * * Yet while this military feature is so administered as to honestly meet the requirement of law and to benefit the college and individual students, it is not permitted to interfere with other educational interests and duties, or to encroach upon reasonable periods of recreation."

An interesting feature of this report is the special report made by the committee of the Trustees appointed to visit similar institutions in other States, more particularly with a view of the opening of the new Experiment Station.

They thus sum up their conclusions as to the future development desirable for their own college.

It should be remembered that although the original character of this College contemplated no technical instruction except in agriculture, the Act of Congress of July, 1862, which was accepted by this State in 1864, and which now contributes more than half the annual income of our College, was much broader in its terms. Consequent upon this, the Laws of Maryland of 1865, chapter 178, define "the leading object" of the Maryland Agricultural College to be, "to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes, in the several pursuits and professions of life." The Committee find that in the College where mechanic arts departments have been established, they have proved useful and attractive and have very materially increased the number of students. The Committee therefore ask the Board whether the time has not arrived for the Maryland Agricultural College to enter upon this heretofore neglected branch of its legal duty. If so, special application should be made to the Legislature for the means necessary to provide the plant for instruction in the mechanic arts.

They close with the following excellent suggestion:

"The experience of this Committee leads to the recommendation that at some suitable future time, a similar tour of inspection be made by a committee of the Board, with special reference to the development of the educational branch of this institution.

(Signed:)

F. C. GOLDSBOROUGH,
J. P. SILVER,
DAVID SEIBERT,
Committee."

The following report on Drawing, is by the Professor in charge of

the three departments severally entitled "Military," Mathematical," and "Drawing:"

"DRAWING DEPARTMENT.

During the fall of 1888 and winter of 1889, the Junior class was instructed in drawing plans and elevations of simple models. In the spring of 1889 they were instructed in drawing the perspective of blocks and buildings, with their shadows and plans. During the fall and winter of 1888 and 1889, the Sophomores were instructed in outline free-hand drawing in copy-books. In the spring of 1889, they were instructed in the use of instruments and in simple geometrical drawing. This class, which is now the Junior, has been instructed during the term just closing in the construction of geometrical curves, and the drawing of projections of blocks with their shades and shadows. During the winter of 1890, they will draw plans, elevations and sections of models, and in the spring, perspectives of models and buildings. The Sophomore class, this fall, has been instructed in outline drawing in copy-books. During the winter and spring of 1890, they will draw blocks with lead pencil and begin geometrical drawing with instruments.

Very respectfully, your obedient servant,

A. B. SCOTT,

Second Lieutenant, Thirteenth Infantry, U. S. Army. Professor of Military Science and Tactics, and Acting Professor of Mathematics and Drawing."

The latest catalogue at hand* gives an attendance of 45 students. "To cover the necessary expenses of the year at college, clothing excepted, a single charge is made of one hundred and eighty dollars ($180.00.) This includes board, room partly furnished, heat, lights, washing and the necessary text books."

The Faculty consists of seven Professors. Henry E. Alvord, C. E., is President.

THE UNITED STATES NAVAL ACADEMY, ANNAPOLIS, MARYLAND.

The "Annual Register" for 1881, shows that in the courses of the United States Naval Academy at Annapolis, Free-hand drawing is taught to the Fourth Class of Cadet Midshipman the first half of the year; the second half of the year, Free-hand drawing is continued and the study of Topographical Drawing is taken up.

In the Third class, Topography is taught the first half of the year. After that the study of Drawing does not appear in the list of required studies.

In the course for Cadet Engineers, Drawing is however required through the four years. "Mechanical Drawing and Fabrication," is studied all the year by the Fourth and Third Classes. The same branches are pursued throughout the year by the Second and First Classes; with the addition of "Designing Machinery" and "Marine Engines."

The "Department of Drawing" proper, includes instruction in

*Report of the Board of Trustees of the Maryland Agricultural College and Experiment Station, to the General Assembly, for the years 1888–1889. Annapolis: Maryland Republican Steam Press. Pp. 28.

"Free-hand drawing and practical perspective, topographical and chart drawing."

The Department of Drawing is in charge of a Professor and two assistant Instructors.

The summary of attendance Oct. 1st 1881, gives a total of 161 Cadet Midshipmen, and of 100 Cadet Engineers.

From the concise historical statement which prefaces the latest "Register" at hand,* it appears that the Academy was founded in 1845, by the late Hon. George Bancroft, when Secretary of the Navy, during the administration of President Polk. Mr. Bancroft, whose reputation as the historian of his country seemed, during the later years of his prolonged life, to have swallowed up all public memory of his earlier active life, so that, on the event of his decease, there was very general surprise to learn how much, during the first half of the century, he had contributed to create a part of that history; effected the opening of a "Naval School," with Commander Franklin Buchanan, as Superintendent. "This was placed at Annapolis, Md., on the land occupied by Fort Severn, which was given up by the war department for the purpose." The plan of the school was revised and the school reorganized and named The "Naval Academy," first in 1850. It was still farther changed in 1851, when the corps of Professors was greatly enlarged, the years of study made consecutive, and the general scheme of study arranged substantially as it still continues. It is a technical school for the training of American youth to become Naval officers. "In 1866, a class of acting third-assistant engineers were ordered to the Academy for instruction." This seems to have been done in recognition of the fact that steam propulsion was superseding sails in navigation; eventually, after several experiments, the cadet engineers were given a four years course, and, in 1882, the distinction between "cadet-midshipmen" and "cadet engineers" was abolished and all were ranked as "naval cadets." The law of March 2, 1889, directs that the first class at the beginning of their fourth year shall be divided in two divisions as they have shown special aptitude for the respective duties, and shall pursue the studies to fit them respectively for the line or the engineer corps.

Mechanical Drawing is taught through both terms of the third class and the second class; Mechanics and applied mathematics, through the third and fourth years.—Of course the engineers take the studies relating to applied mechanics, marine engineering and the management of steam.

The Academic staff number 69. There are eleven departments of study each with its separate faculty, besides the Commandant and his staff, and the Superintendent.

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*Annual Register of the United States Naval Academy, Annapolis, Md. Fortieth Academic Year 1889–'90. Washington: Government Printing Office. 1889. Pp. 78.

Captain W. T. Sampson, U. S. N., the Superintendent, assumed command in 1866. The summary of cadets November 23rd 1889, gives a total of 244.

The Massachusetts Agricultural College, Amherst.

The Legislature of Massachusetts, by act passed April 29th, 1863, incorporated a "Board of Trustees of the Massachusetts Agricultural College." The leading object of this institution was stated in the exact language of the act of Congress, of 1862, known as the land grant bill for the establishment of Colleges "for the benefit of Agriculture and the Mechanic Arts." Two thirds of the income arising from the United States Land Grant fund under the law of 1862, was to be given annually to this institution; the remaining one third, was given to the Massachusetts Institute of Technology.

The Trustees were empowered to select the site of the college, and to make all provision for its "organization, government, and course of study, * * * subject to the approval of the Legislature."

Several towns sought to secure the new institution, but the town of Amherst, Hampshire County, by a money subscription of $75,000, succeeded.

The Attractions of Amherst.

This charming college town is situated on the low hills overlooking from the east the valley of the Connecticut, which there flows through a region world-renowned for its scenes of quiet beauty. The fact that it was already the seat of an old and famous literary college, well supplied with ample museums, and libraries, and with a corps of distinguished professors, was no small inducement leading to its selection as the home of the new institution; to which there was thus afforded access to so many most desirable facilities.—A farm of nearly four hundred acres, favorably situated, was purchased and the erection of the necessary buildings at once begun.

The Opening of the College.

It was not till late in the year 1867, that the College, under President Chadbourne, first opened for the reception of students.

In 1869, Col. William S. Clark, became President, and continued to hold that position for eleven years. During his Presidency many novel and interesting investigations and experiments were made, the results of which were recognized as valuable contributions to knowledge. The Annual Report of 1880, contains a list of 27 subjects that have been systematically investigated, many of them with practical results of great value.

The Importance of the Work of this College.

From this day forward, said Professor Agassiz, when a single one of the above papers was presented to the State Board of Agriculture in 1873,—from this day forward, the Agricultural College at Amherst has its place among scientific institu-

tions, if it had not before; for only those institutions have a place in the scientific world which do something, and this is something extraordinary: it is a revelation to physiologists. Let me say to those who have not thought that the Agricultural College was doing anything worth its expense, that the production of this one paper has amply paid for every dollar which the State has thus far bestowed upon the institution.

Equally unqualified testimony might be presented with reference to the high character and value of nearly every one of the investigations named in the above list. Every land-surveyor, for instance, knows that previous to the establishment of permanent monuments in every county of the State, giving the accurate meridian lines, the means of correcting his instruments were comparatively difficult of access; and when it is considered that very many of our farms are bounded and described by the points of the compass, often for long distances, it is easy to see that the College has had its influence upon nearly every farm in the State, and that, too, in more ways than one. It can justly challenge comparison with the work of any other similar institution in the country, both in its contributions to science and to the methods and results of intelligent practice.

But these investigations, as already intimated, are secondary, and subordinate to the chief object of the institution—the education of young men for the practical pursuits of life.

It was in recognition of the extended and high reputation of this College, that the Japanese Government sought the services of President Clark, in order to establish a similar College in Japan. This he successfully accomplished, having obtained leave of absence from Amherst, in 1877–'78.

The development of the College has been directly in the line of experiment and of scientific agriculture. There is a flourishing horticultural department; with "conservatories, nurseries, fruiteries and landscape gardening areas." Much attention is also given to military training, which is made by the provisions of the original United States Law, an essential feature of these institutions. There appears little evidence of any special direction towards mechanics;—a ready explanation of such apparent neglect of one of the main provisions of the Land Grant Law, is found in the fact that all the courses of study relating to "Mechanics", were amply provided for by the Massachusetts Institute of Technology; which, receiving one third of the Land Grant fund, should provide for at least one third of the required studies.—

Drawing, however, has always been an integral part of the course at Amherst. The length of the course is the usual college one of four years. The catalogue of 1882, shows that three hours a week are allotted to Free hand drawing, through the second term of Freshman, Sophomore and Junior years.

President Clark, was succeeded in 1880, as President, by Hon. Levi Stockbridge, for many years the Professor of Agriculture. President Stockbridge, having resigned to take effect March 18th, 1882, Paul A. Chadbourne, S. T. D., LL. D., was chosen to succeed him. There has been for years a total annual attendance of about 100 students, there were 162 in 1878, and 138 in 1879, the Report of 1882,

shows a total for 1881–'82, of 113; 80 of these in the college classes, 17 were graduates of 1881; the others "special," or "post graduate," students.—

The commencement of 1887, happening on the 25th anniversary of the passing of the Land Grant Law by the Congress of the United States, was taken as an occasion for honoring this event, and commemorative addresses by distinguished speakers were made.

These will be found recorded among the appendices to this volume.*

Henry H. Goodell, M. A. succeeded Dr. Chadbourne as President.

The annual statements of the college are made in the form of Reports to the Legislature, by the Trustees of the College; and contain the reports to the Trustees, made by the President, and the members of the Faculty in charge of their respective departments; with lists of the Trustees, of the Faculty, and of the students.

In the 28th Annual Report, of January, 1891, there is an analysis of the attendance of the year, which shows that all the counties of the State, except Barnstable, Dukes and Nantucket, three sea coast counties, are represented among the students by from 1 to 42 individuals. "Ninety-three per cent were residents of the State; while of the remaining seven per cent, one third were foreigners attracted hither by the advantages of the course."

That the college has steadily grown in the favor of the people, the following table of attendance during the past few years is proof:

1884	111	1888	149
1885	121	1889	146
1886	131	1890	173
1887	132		

A very interesting report by Professor Fernald, on Agricultural Museums, accompanies this report.

The following is the statement of the present condition of the college made by Acting President Fernald in the latest Report † at hand.

To the Honorable Senate and House of Representatives.

During the past year the college has been very prosperous, though no great changes have occurred. President Goodell has been ill because of overwork, and was granted a leave of absence during the fall term, which was spent in Europe. His duties were assigned to me during his absence, and it is but just to say that the success of the fall term was due to the excellent condition in which he left the college, and to the hearty co-operation and assistance of the members of the faculty.

A fine class of forty-three students was admitted in September, making the whole number now in college larger than at any previous time in the history of the institution. This gradual growth during several years past is undoubtedly due to several causes: first, the able administration of the college; secondly, the efficient corps of teachers associated in its management; thirdly, the higher standard of scholar-

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* See Appendix Z.

† Twenty-Ninth Annual Report of the Massachusetts Agricultural College. January, 1892. Boston: Wright & Potter Printing Co., State Printers. 18 Post Office Square. 1892. Pp. 100.

ship required for admission, and for promotion from one class to another; fourthly the better and fuller knowledge of the college and its aims and purposes by the citizens of the Commonwealth; and, lastly, the encouragement offered by the provisions of the labor fund.

This higher grade of scholarship which the institution now maintains will be a source of satisfaction to the graduates of the college, since it will prove an excellent recommendation for them when seeking situations, and will result in a far better preparation for agricultural pursuits. It is not the wish or purpose to crowd the dull or slow students out of college, provided they are faithful and accomplish all they are able; but it is the express purpose to compel the indolent and negligent to do good work or to leave.

An important paper on the value of "Military instruction in Educational Institutions" by Lieut. Lester W. Cornish, is given in an Appendix to the Report of 1892.

Freehand Drawing, is taught during the winter term of Freshman year; and Mechanical Drawing, during the winter term of Sophomore year.

The estimate of annual expenses per student, varies from $231.15 to $371.55.

The following Summary gives the attendance in detail.

SUMMARY.

Resident Graduates	17
Graduates of 1891	18
Senior class	22
Junior class	26
Sophomore class	55
Freshman class	43
Total	181
Counted twice	3
Total	178

The Faculty numbers fifteen Professors. Henry H. Goodell, LL. D., is the President.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, BOSTON.

The Board of Trustees of the Massachusetts Institute of Technology, were incorporated by the State Legislature, in 1861, "for the purpose of instituting and maintaining a society of Arts, a Museum of Arts, and a School of Industrial Science, and aiding generally by suitable means, the advancement, development and practical application of sciences in connection with arts, agriculture, manufactures, and commerce."

In 1863, the Institute of Technology was designated by the Legislature to receive, annually, one third of the income of the fund derived from the United States Land Grant.

The Institute, possesses a stately Building on Boylston street, Boston, not far from that neighborhood of fine architectural structures, which includes, among others, the Museum of Fine Arts,

Trinity Church, the New "Old South" Church and the new building of the Boston Public Library which give to that part of the city a striking and beautiful character.

COURSES OF INSTRUCTION.

"The Massachusetts Institute of Technology provides a series of scientific and literary studies and practical exercises, embracing pure and applied mathematics, the physical and natural sciences, with their applications, drawing, the English language, history, political economy, international and business law, French and German, with other modern languages, if desired. These studies and exercises are so arranged as to offer a liberal and practical education in preparation for active pursuits, as well as a thorough training for most of the scientific professions.

The following regular courses, have been established:

I. A Course in Civil and Topographical Engineering.
II. " " " Mechanical Engineering.
III. " " " Mining Engineering, or Geology and Mining.
IV. " " " Building and Architecture.
V. " " " Chemistry.
VI. " " " Metallurgy.
VII. " " " Natural History.
VIII. " " " Physics.
IX. General Courses (A. B, and C).

All the regular courses of the Institute, whether professional or general, extend through four years, and for proficiency in any one of them, the degree of S. B., Bachelor of Science, is conferred.

The studies of the first year, are common to all the courses.

"*The Instruction in Drawing.*—During the first year, instruction is given to all regular students in the principles of Free-Hand and Mechanical Drawing, and a large amount of time is devoted to practice in the drawing room, to enable the student to acquire the necessary skill and to prepare him for his future work. In subsequent years, Drawing is continued in connection with the professional studies."

Practice in drawing is required through nearly all the courses and as a matter of necessity enters largely into the courses in engineering.

"*The Instruction in Civil Engineering* is given by means of lectures and recitations and by practice in the field and in the drawing rooms. The use of the various instruments for measuring lines and angles, and of the level, plane-table, etc., is taught mainly by actual work in the field. The field-work embraces the various kinds of land surveying, Topography, Hydrography, and the several operations with the level and transit involved in Railroad, Hydraulic and Sanitary engineering. The work in the drawing room consists in representing upon paper the surveys made in the field, and in making both working drawings and finished plans from direct measurements of actual engineering structures, a large number of which are found in the immediate neighborhood of the Institute.

* * * * * * *

The Instruction in Mechanical Engineering is given by means of lectures and recitations, and by practice in the drawing rooms, and in the Laboratory of Steam Engineering. Occasional excursions are made to enable the students to witness running machinery, and manufacturing processes.

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The practice in Drawing is carried on in conjunction with the lectures, and text-

book study. It comprises tracing, copying, sketching from the structure, machine or motor, scale drawing from sketches, and the representation by curves of the results of experiments or of mathematical investigations; to which is added the reproduction of drawings by the "Blue Process."

In Architecture, very complete instruction is given—a large collection of architectural casts, mostly deposited in the Boston Museum of Fine Arts, belongs to the Institute. A full description of this department will be found elsewhere in this Report.

"*The Instruction in Architecture.*—It is the object of this department to give to its students the instruction and discipline that cannot be obtained in architects' officès. The course is, however, practical as well as theoretical, and, besides the scientific study of construction and materials, it comprises the study of building processes, and of professional practice and procedure, as well as that of composition aud design, and of the history of the art. It is so arranged as to meet the wants not only of young men who propose to pursue a compresensive course of study but of those who are looking only for such an elementary training as shall qualify them for positions as draughtsmen.

The more strictly professional work begins in the second year, the first half of which is given to the study of the Five Orders and their applications and to Greek and Roman Architectural history. At the same time the students of the third and fourth years attend a series of lectures upon ornament and composition, or upon the theory of architecture. In the same way the study of specifications and working drawings is pursued by the two classes together, carpentry and its related subjects occupying one year, and masonry and stone-work the next. In the last half of the year the historical studies are continued, the second and third year classes attending the same exercises. The mediæval period, from the fall of the Roman Empire to the fall of Constantinople, and the modern period, including that of the Rennaissance, are taken up in alternate years, so that each class is carried over the whole ground.

During the third and fourth years the students are constantly practiced in original design. Each set of drawings is examined and criticised before both classes.

Special exercises are also had in shades, shadows, perspective, and the perspective of shadows, and in tracing and sketching, and drawing upon the blackboard, and in sketching, measuring, and drawing out buildings already erected." * * *

"*The Architectural Museum.*—Several thousand photographs, prints, drawings, and casts have been collected for this Department, by means of a special fund raised for the purpose.

To these collections the following additions have been made, mostly by gift:—

A considerable collection of photographs, lithographs, and drawings, presented to the Institute by French, English, and American architects, taken from their own works, including sets of actual working drawings, with details and specifications."

In the instruction in Zoology and Palaeontology, great use is made of drawing:

The handling and drawing of specimens by the students is an essential feature of the method of instruction. The lectures of the instructor are devoted largely to explanatory demonstrations of the specimens which the students are at the same time drawing." * * *

The Instruction in Shop Work.—Shops or laboratories have been provided, and furnished with the more important hand and machine tools, so that the student may acquire a direct knowledge of the nature of metals, and woods, and some manual skill in the use of tools.

Practical instruction in the nature of the materials of construction, and in the typical operations concerned in the arts, is considered a very valuable adjunct to the theoretical treatment of professional subjects. Students in the course of Mechanical Engineering are required to devote a considerable amount of time to work in Carpentry, Wood Turning, Pattern Making, Moulding and Casting, Forging, Chipping and Filing, and Planing and Turning the metals, the design being to learn the principles, and not to manufacture articles for sale or use.

Students in other departments will be allowed to take shop work when the time can be arranged so as not to interfere with their regular studies.

There is also a School of Mechanic Arts, under the care of the Institute.

SCHOOL OF MECHANIC ARTS.

A School of Mechanic Arts, in which special prominence is given to *manual* instruction, has been established for those who wish to enter upon industrial pursuits rather than to become scientific engineers.

This school is designed to afford such students as have completed the ordinary grammar-school course an opportunity to continue the elementary scientific and literary studies, together with mechanical drawing, while receiving instruction in the use of the typical tools for working iron and wood.

The shop work is conducted upon a plan designed at the Imperial Technical School of Moscow, Russia, and carried out there with most satisfactory results. Its exact and systematic method affords the direct advantages of training the hand and eye for accurate and efficient service with the greatest economy of time; and the instruction in the use of tools and materials has also proved a valuable aid in intellectual development.

The shop courses of the school are as follows:

First year.—I, Carpentry and Joinery; II, Wood Turning; III, Pattern Making; IV, Foundery Work.

Second year.—I, Iron Forging; II, Vise Work; III, Machine Tool Work.

The full course includes two years of theoretical and practical studies combined, and students who successfully complete it will receive a certificate. Students will be received for shorter times, and for special portions of the course. When it is desired, such provision will be made for advanced and specific shop work as is consistent with due attention to the regular classes.

Students in this school are recommended to attend the exercises in Military Drill, and hours will be so arranged as to allow them to do so without detriment to their studies.

Applicants for the regular course must be at least fifteen years of age, and must pass a satisfactory examination in Arithmetic, Geography, and English Composition.

The tuition is $150 a year, with no extra charge for the use of tools or materials, used in the regular exercises. Special students, taking the same amount of shop work only as the regular class shop work, will be charged less. The student is entitled to the products of his work. Students, while on the premises of the Institute, are expected to remain in the study room, except when at recitations or in the work shops. A monthly return of absences is made to the parent or guardian.

FIRST YEAR.

First Term.—Shop Work,—Carpentry. Algebra commenced. English Composition. Mechanical and Freehand Drawing.

Second Term.—Shop Work,—Wood Turning, Pattern Making. Foundry Work. Plane Geometry. English Composition. Mechanical and Freehand Drawing.

SECOND YEAR.

First Term.—Shop Work, Forging. Algebra completed. Elementary Physics. English Composition. Mechanical Drawing.

Second Term.—ShopWork,—Vise Work, Machine Tool Work. Geometry. Physics. English Composition. Mechanical Drawing.

The beginning and ending of the school-year and the days of entrance examinations are the same as in the School of Industrial Science. See Calendar, page 2.

The following account of the practical workings of this school is taken from the Report of the Hon. Wm. H. Ruffner, of Virginia, made to the authorities of the Virginia Agricultural Mechanical College of a visit made in 1880, to this class of schools in the North.

I observed nothing peculiar in the course of mechanical engineering; but the school of mechanic arts is full of suggestion. It is designed to afford such students, as have completed the ordinary primary school course, an opportunity to continue elementary, scientific and literary studies, together with mechanical drawing, while receiving instruction in the use of the ordinary tools for working iron and wood. * * *

I witnessed the third lesson given to a class of eight in blacksmithing. The first lesson was in the management of the fire and the handling of the tools. The second lesson was commenced by calling attention to a drawing on the wall, showing first a piece of square iron, then a succession of shapes with dimensions, into which that iron was to be hammered. When I entered a regular blacksmith was hammering the piece of iron into one of the shapes. His class of eight boys, in check shirts and leather aprons, stood around the anvil watching and listening. When the example had been shown and expounded, each student went to his forge with a piece like the one operated on, and they simultaneously went to work to imitate what they had just witnessed, under the supervision of the master workman.

The first lesson in the carpenter shop is on the chalk line, second the saw, third the plane, and so in regular order, finishing the course with framing a house having a winding staircase, on a small scale. There is the same sort of skill called for in arranging shopwork that there is in arranging bookwork, and every lesson in the shop is grade-marked like any other lesson. Every student becomes the owner of the articles which he makes. Nothing is made for sale. The boys, whilst in wood, work nine hours a week; when in iron, six hours a week. There is only one master workman in wood, and one in iron.

Prof Runkle, who has been one of the leading men of the school, would prefer a three years' course of both study and labor for mechanics, and three hours labor every day. Practical education in mechanics is divided into schools of in-struction and schools of con-struction. This school is one of in-struction, where students are taught principles, and the use of tools in the two great branches of mechanical industry. The school of construction is the shop and the factory where work is carried on for its economical results. The school of instruction finds its profit exclusively in the education of the boy; the school of construction in the products manufactured. The boys leaving this school enter the regular work-shop of business, and there soon rise into practical importance.

The conductors of the Boston School feel very confident that they have struck upon the true idea for making educated and skilful mechanics. They claim a variety of advantages for their system. Some of these are social, in protecting society against some forms of dictation. As to the students, the school first may show that a boy is not fitted to be a mechanic, and this may be worth much to the boy and his friends. But if a boy is to become a mechanic he gets an amount of scholastic education and knowledge of drawing, which of itself would strengthen

his ability. If he takes the military he gets the slouch driven out of him. But the chief point of importance is in the formation of character under circumstances so much better than those which usually surround an apprentice boy. And as heretofore intimated, he really has peculiar advantages in learning the use of tools. He has a selected master workman for a teacher. He is constantly and carefully instructed, and carried rapidly forward—his improvement and not the employer's profit being the end constantly aimed at.

The variety of work also has a *liberalizing* effect on the mind similar to that produced by varied studies. And finally the habit is created of considering principles, and referring everything to its scientific basis—which will insure intellectual and mechanical progress through life. There were forty-two students in this course last year.

There are also free evening classes established by the Trustees of the Lowell Institute.

FREE COURSES OF INSTRUCTION.

The Trustee of the Lowell Institute has established, under the supervision of the Institute of Technology, courses of instruction, generally given in the evening, and open to students of either sex, free of charge.

These courses are more or less varied from year to year by the omission or interchange of particular subjects, but include in their entire scope instruction in mathematics, mechanics, physics, drawing, chemistry, geology, natural history, biology, English, French, German, history, navigation, and nautical astronomy, architecture, and engineering.

The Lowell School of Practical Design, in charge of Mr. Charles Kastner, is also under the Institute. This school is described at length elsewhere in this Report.

The following is the cost of attendance in the regular course of the Institute.

"*Fees.*—The fee for regular students is $200 per year, $125 at the beginning, and $75 at the middle (first Tuesday in February) of the school-year. For one-half, or any less fraction, for the school-year, the fee is $125. Payment is also required of the cost of apparatus broken, or used up in the laboratories."

The catalogue for 1881–'82, gives a total of 390 students in attendance in all the Departments of the Institute. 164 of these, are in the regular classes, 15 are Graduate Students. There were also 138 special students, taking special or partial courses.

This Institute, founded by the late distinguished Professor William B. Rogers, who was succeeded in the Presidency by John D. Runkle, LL. D., who has recently been succeeded by General Francis A. Walker, LL. D., sustains deservedly a high reputation.

The latest catalogue,* is an admirable example of good book making, in type and paper, as well as in clearness of statement and arrangement of material. The table of contents, running page titles, schedules of "Courses," and of "Topics," showing the several studies, and the time given to each; List of Officers and Instructors, Regis-

*Massachusetts Institute of Technology, Boston. Twenty-Eighth Annual Catalogue of the Officers and Students, with a statement of the courses of instruction and a Register of the Alumni, 1892-1893. Boston: Press of H. G. Collins, 15 Milton Place. 1892. Pp. 256.

ters of undergraduates, and graduates, and alphabetical index, so facilitate reference to the contents of the book, as to render this almost worthy to be taken as a model for the Catalogues of Educational Institutions.

In a concise "historical sketch," it is stated that "the school was opened in February, 1865, with twenty-seven pupils." This is in striking contrast with the present attendance; as will be seen in the "summary" given later.

The following account given of the buildings now occupied by the Institute, as contrasted with the single building in which it opened, furnishes additional proof of a remarkable growth.

BUILDINGS.

The buildings now occupied are, the Rogers Building, on Boylston Street, devoted to instruction in mathematics, literature, history, political Science, geology, mineralogy, and biology; the Walker Building, at the corner of Boylston and Clarendon Streets, mainly devoted to the departments of chemistry, physics, and electricity, and to instruction in language; the Engineering Building, on Trinity Place, devoted to the engineering laboratories and to instruction in mechanics and hydraulics, and in mechanical and civil engineering; a series of Workshops, on Garrison Street, with a room devoted to the Lowell School of Design; a Gymnasium and Drill-hall, on Exeter Street. In order to provide increased facilities for the departments of Architecture, Physics, and Chemistry, an Architectural Building, adjoining the Engineering Building, has recently been erected, and is now occupied by the first-named department. The rooms thus released in the Walker Building meet the urgent needs of several other departments."

In the "courses of Instruction," "Electrical," "Chemical," and "Sanitary," Engineering; have been added.

The following statement shows the methods of education adopted.

Instruction is given by lectures and recitations, and by practical exercises in the field, the laboratories, and the drawing-rooms. Text-books are used in most, but not in all subjects. In many branches the instruction given differs widely from available text-books; and, in such cases, notes on the lectures and laboratory work have been printed, either privately or by the Institute, and are furnished to the student at cost. A high value is set upon the educational effect of laboratory practice, drawing, and field-work. Besides oral examination in connection with the ordinary exercises, written examinations are held from time to time. Near the close of the months of January and May general examinations are held.

The prominence given to the study of drawing, is shown as follows:

DRAWING AND DESCRIPTIVE GEOMETRY.

Instruction is given to all regular students in the principles of Geometrical, Mechanical, and Freehand Drawing; and a large amount of time is devoted to practice in the drawing-room, to enable the student to acquire the skill necessary for his future work. Drawing is also continued in connection with the professional studies.

The exercises in Descriptive Geometry are of two kinds. In the lecture-room the instruction is given by means of models and diagrams, and also by the use of text-books. In the drawing-room the student is drilled in the solution of problems designed to illustrate the work of the class-room, and to make him thoroughly familiar with the subject.

The instruction in Freehand Drawing includes an elementary course taken by all regular students, and more advanced work in the departments of architecture, biology, and geology. For students in architecture, studies in charcoal are usually required, and opportunity is afforded for those who have made satisfactory progress to sketch in pencil, pen and ink and with the brush. Importance is attached to drawing from memory and to rapidity of execution. Students in biology and geology pay special attention to specimen drawing.

Besides the large and well-equipped freehand drawing rooms of the Institute, the Museum of Fine Arts offers excellent opportunities for drawing from the cast and regular exercises for advanced students are held in its galleries.

The Institution is abundantly supplied with fully equipped Laboratories; Physical, Engineering, Chemical, Biological and Mechanical.

The facilities for shop work, have been already stated briefly in the pages immediately preceeding, and at length, in the account of the "School of Mechanic Arts", on pages 695–710, of this volume.

Its facilities in the way of Libraries, are thus set forth:

LIBRARIES.

The library of the Institute contains twenty-six thousand volumes and several thousand pamphlets. It is divided into a general library, containing certain books of reference, and nine department libraries, which contain a careful selection of text-books, special treatise, monographs, etc., and of periodical publications germane to the work of the respective departments. They are thus working libraries, accessible to all students; and valuable experience in the use of them is acquired before the completion of the regular courses, either incidently to the preparation of theses, or in connection with lectures or recitations. The division of the library enables each student to consult the works needed by him with the least possible inconvenience and loss of time.

The students have full use of the valuable library of the Boston Society of Natural History, of the extensive collection of the Boston Public Library, comprising more than five hundred thousand volumes in all departments of knowledge, and of the library of the American Statistical Association.

Many libraries of scientific societies, of individuals, and of private corporations, rich in complete sets of the scientific periodicals of all countries, and of the publications of leading scientific societies throughout the world, are, through the courtesy of the owners, open to advanced students of the Institute.

The number enrolled, in the Register of students in attendance, is in striking contrast to the little body of 27 students who met in 1885, on the opening of the school, as already mentioned.

SUMMARY.

Graduate students	48
Regular students, 4th year	138
Regular students, 3rd year	144
Regular students, 2nd year	175
Regular students, 1st year	314
Special students	286
Total	1,105
Deduct names counted twice	45
	1,060

The "Officers of Instruction" number 114, with an additional list of sixteen Teachers and Lecturers, for the current year. Francis A. Walker, PH. D., LL. D., is the President.

STATE AGRICULTURAL COLLEGE OF MICHIGAN, LANSING, MICHIGAN.

This College, established in 1855, by an act of the legislature, in accordance with a provision of the State Constitution adopted in 1850, was opened in May, 1857, and is claimed to have been "the first of the existing Agricultural Colleges of the country." It is situated three miles distant from Lansing, and possesses a farm of 676 acres.

The Legislature accepted the United States land grant of 1862, and designated the Agricultural College, as the institution to receive it.

The course of instruction has, from the first, been especially agricultural; and manual labor, on the part of the students, is required; three hours each day being so occupied.

Drawing is taught the last six weeks of Junior year. "The course consists of the principles of projection as used in simple mechanical and architectural pursuits."

DRAWING.

Description and uses of drafting instruments; mounting paper; lettering and ornamentation. Projections,—theory and problems; elementary intersections and developments; constructions in wood; principles of shades and shadows, of perspective; elementary mechanical drawing. Minifie's Geometrical Drawing is used as a text-book, and a set of finished plates is required of each student.

Books of reference.—Warren's Perspective and Drafting Instruments; Keuffle & Esser's Book of Letters, The Draughtman's Manual, Appleton's Cyclopedia of Drawing, Mahan's Industrial Drawing.

The catalogue of 1879–80, shows much attention to practical Agriculture and Horticulture, with the slightest possible to the Mechanic Arts. The total attendance of students for 1879–80, is 232.

The latest catalogue* at hand, states that "the appropriations of the Legislature of 1887, have enabled the college to materially enlarge its facilities in the direction of horticultural science and art, and in the mechanic arts." "The department of Military Science and Tactics, was established in 1884."

The College is located on the banks of the Red Cedar River, about three miles east of the city of Lansing. The buildings, mostly of brick, stand upon a slight eminence among the forest trees, which have been purposely retained. The grounds about the college buildings and residences have been laid out with considerable regard for ornamental effect. They are under the care of the Horticultural Department.

There are two courses, each of four years, known as "The Agricul-

*Catalogue of the Officers and Students of the State Agricultural College of Michigan, together with other General information concerning the College. Thirty-Third year, 1889–90. Agricultural College, P. O. Mich. (Near Lansing.) Published by the College. 1890. Pp. 68.

tural course," and "The Mechanical course." In the former, Free-hand Drawing is required during one term of Freshman year. In the Mechanical course, Drawing in some form, and Shop Work, are required in each term of the first three years. In Senior year, "Shop Work" in the first term, and "Machine Design" in the second. In the third term, "Thesis work," takes the place of shop practice.

The following shows the instruction in drawing:

DRAWING—FREE HAND.

The study consists of two hours practice per day for one term in the Freshman year for all students. It is designed to train the eye to see correctly and the hand to represent accurately what the eye sees. Drawings are made from plates, casts, or nature, according to the progress of the student. Further practice is given in other courses, as in botany and zoology, where drawing is required.

DRAWING—MECHANICAL.

This, in addition to the free-hand drawing of the first term of the Freshman year, constitutes the drawing of the mechanical course.

Mechanical Drawing is taught in some form one hour per day for nearly the entire remainder of the course.

The subjects for the various terms are as follows:

FRESHMAN YEAR.

Second Term.—Geometrical and Projection Drawing.

Third Term.—Elementary Descriptive Geometry.

SOPHOMORE YEAR.

First Term.—Descriptive Geometry.

Second Term.—Shades, Shadows and Isometric.

Third Term.—Perspective, Tracings, and Blue Prints.

JUNIOR YEAR.

First Term.—Elements of Machines.

Second Term.—Working Drawings—Machines.

Third Term.—Working Drawings—Steam Engine.

SENIOR YEAR.

Original Designs and Thesis Drawings.

The student in Mechanical Drawing will need draughting board 20 by 25 inches, T square, one six inch triangle with angles 90°, 45° and 45°, one 8 inch triangle with angles 90°, 60° and 30°, a few first-class German-silver draughting instruments, among which should be one drawing pen, one bow pen and pencil, one pair five-inch compasses, with pen, pencil and needle points, one very small irregular curve, and one triangular scale divided into sixteenths, twelfths, fiftieths and other scales.

The facilities of the College for work in the Mechanical Laboratory, and in the wood and iron shops, are thus stated:

MECHANICAL LABORATORY AND WORK SHOPS.

This building furnishes a large lecture room for instruction, in the principles of mechanics, a physical laboratory, class room in engineering, a draughting room, and a blue print room.

In this building there is a complete blacksmith shop 30 ft. square, supplied with benches, forges, tools of all kinds, and a Sturtevant pressure-blower. There is also an iron working shop, 50 by 60 feet, furnished with an engine, nine engine lathes, a planer, a shaper, a universal milling machine, a power drill, emery wheels,

benches, vises and tools and machinery necessary to a complete shop. Of the shop tools, four lathes besides a twenty-five horse power engine and a great variety of smaller tools have been made by the students. The work on these tools will compare with that on any in the machine shop. It is the intention to build, as far as possible, all tools needed by the shop. All such tools as blacksmith's tongs, cold chisels, and lathe tools are made, tempered, and put in order by students in the shop. A set of surface plates 12 by 12 has been completed.

There is also a large wood working shop, two stories 50 by 60, supplied with five lathes, a jig saw, benches, vises and forty-two sets of carpenter's tools."

The work required in the shops, is thus outlined.

SHOP PRACTICE.

The shop practice is of the nature of laboratory work, and is without pay, and is chiefly incidental to the mechanical course.

A series of exercises is selected principally with reference to giving the student skill. So far as possible these exercises consist of practice on articles intended for use, and are constructed under the immediate oversight of a skilled workman. The shops are run, as far as possible, the same as actual manufacturing institutions. The results attained by trial of such methods for sixteen years in similar institutions have shown conclusively that work in connection with instruction, and parallel to it, gives the student more skill than can be obtained without such instruction in twice the time by shop work alone. Again, the shop work is of value as to practical illustration of the precepts taught in the class room.

WORK IN WOOD SHOP.

The Mechanical Freshmen spend the year in the wood shop. The Agricultural Freshmen spend part or all of one term in the wood shop.

The First Term.—The work done relates to the primary operations of carpentry, such as exercises relating to the use of tools, putting tools in order, and the construction of a series of exercise graded according to skill of the student. The work of this term is confined principally to carpenter work and joinery. Practice is given in the construction of mortise and tenon and dovetail and other joints.

Second Term.—During the second term the work relates to advanced joinery, turning and cabinet making. Some practice will also be given in the use of machine tools for working wood.

Third Term.—During the third term the student learns the arts of pattern making and of moulding. The patterns are all constructed accurately from drawings. In the foundry the student moulds his own patterns, and pours them either with a special fusible metal or brass.

So far as is consistent with good instruction, the work of the wood shop is applied to articles actually to be used. Out of the regular practice hours students are allowed the use of their case of tools for private work, whenever the instructor can be present and otherwise when possible, without detriment to the tools. Mechanical ability is encouraged in every possible way. Each student in the shop (or each two students) has assigned for use a case of tools, consisting of a set of four planes, brace and set of bits, four saws, hammer, draw shave, set of chisels, set of gouges, try square, bevel square, marking gauge, square, brad awl, oil stone and oil can. No one else is permitted to use these tools, so that the students to whom they are assigned can be held responsible for their condition. No tools are permitted to be taken from the work room.

WORK IN THE IRON SHOP.

The work in the iron shop extends through the remainder of the course, and includes the practical operations of forging, vice work, finishing, machine work and

casting. This work is all applied toward the construction of some useful article or machine. The students have already built one power fret saw, one fifteen-inch turret lathe, two fifteen-inch engine lathes, three twelve-inch engine lathes, one steam pump, fine lathes for the wood shop, one twenty-five horse power engine, and a fifty-incandescent-light dynamo, besides various small tools. A fifteen-inch shaper, a combination buzz saw, and several smaller articles are in the works and will be finished during 1890. In the forge shop tools are made and dressed and a considerable amount of welding and forging done. The equipment consists of forges for eleven fires, with anvils and tools for each.

Accurate record is kept of the progress of each student, and at the end of his course, if desired, papers will be furnished giving record of skill.

Besides the required work, which is usually eight hours per week, students are encouraged to attain additional skill by having allowed to them, when circumstances will permit, the privileges of the shop for any work which they may undertake for themselves, on Saturday forenoon. Several students have built vertical engines of from 1½ to 6 horse power.

The iron shop is provided with a separate tool room, and is conducted the same as a manufacturing establishment.

During the Autumn term the agricultural Sophomore work in the blacksmith shop in four sections, each section working three weeks, ten hours per week.

The catalogue for 1889–'90, shows a marked increase in attendance over that of ten years before.

SUMMARY OF STUDENTS.

	Mechanical.	Agricultural.	Special.	Total.
Post Graduates	....	....	30	30
Seniors	9	28	....	37
Juniors	15	34	....	49
Sophomore	28	52	....	80
Freshmen	59	91	....	150
Special	2	5	16	23
Total	113	210	46	369

"The faculty and other officers" number 26. Oscar Clute, M. S., is President.

Colleges Of Agriculture And The Mechanic Arts, (University Of Minnesota), Minneapolis, Minnesota.

The University, was the result of the United States land grants of 1849 and 1851; giving in all four townships of land for its endowment.

The building was begun in 1857, but, the immediate financial revulsion followed by the War of the rebellion, deferred completion; so that, as is stated in the Calendar for 1881–'82, "The University practically dates its organization from the law of the State approved February 18th, 1868, entitled an Act to reorganize the University of Minnesota, and to establish an Agricultural College therein." The United States Land Grant of 1862, was given to this college. A pre-

paratory department was opened in October 1867, and the College proper, in the autumn of 1869.

EQUIPMENT.

CAMPUS.

The University is situated in the city of Minneapolis, on the east side of the Mississippi river, about one mile below the Falls of St. Anthony, on an elevated bluff in full view of the same. The grounds are now about forty acres in extent, undulating in surface and well wooded with native trees. The plans for the embellishment of the grounds, made by Mr. H. W. S. Cleveland, of Chicago, will be carried out as fast as means can be afforded. Meantime such are the natural advantages of situation and contour, the grounds are very attractive.

The experimental farm of the Agricultural College is situated a short distance below, near the east bank of the Mississippi.

BUILDINGS.

The general plan of the buildings contemplates a central academic building, and grouped around it, additional structures for the separate departments or colleges.

The Legislature of 1881 appropriated the sum of $30,000 a year for six years for the erection and outfit of the following additional buildings: A farm-house, a building for the College of Mechanic Arts, a military building, an astronomical observatory, a museum and a library.

There is a main Building of 3 stories, 180 feet long by 90 in width. The Agricultural College building is a spacious one of brick. The provisions for teaching in Drawing, and in the Mechanic Arts, are thus set forth:

DRAWING ROOMS.

Room 45 in the main building, 47×30 feet, is furnished with drawing tables for the use of classes in Geometrical and Free Hand Drawing. There are also cases and cabinets for holding drawings and drawing boards. A considerable collection of prints, drawings and models for lessons and illustrations has been made.

WORK SHOPS.

The Work Shops of the College of Mechanic Arts are temporarily provided for in three rooms in the basement of the Agricultural College. (1) The vise shop, containing two benches with double sets of drawers, so that thirty-two students can be accommodated in two reliefs. This shop is now provided with ten vises and the necessary tools for giving thorough instruction and practice in filing and chipping. (2) The forge shop, which contains eight forges and anvils, and all tools required for the usual manipulations of the blacksmith. This shop also contains a six-horse power engine and boiler for furnishing power; a starter and pressure blower for providing blast, and an exhaust fan for removing smoke and dust. (3) The wood shop, which at present contains only benches and vises sufficient for accommodating thirty-two students in two sections. The remainder of the equipment has been authorized, and will be procured as soon as needed.

The University is open, free of tuition charges, to all persons over fourteen years of age who pass the requisite examinations; with the proviso, however, that no one shall be admitted to the preparatory collegiate department who can receive similar instruction in the public schools.

The preparatory department offers three courses, "Classical, Scientific, and Modern."

The College of Science, Literature and the Arts presents likewise three courses of study:

1. A course in Arts;
2. A course in Science;
3. A course in Literature.

These lead, respectively, to the degrees of Bachelor of Arts, Bachelor of Science, Bachelor of Literature.

* * * * * * *

The College of Mechanic Arts offers three advanced or university courses, based on the Scientific Course of the Collegiate Department, which lead to appropriate baccalaureate degrees:

1. A Course in Civil Engineering;
2. A course in Mechanical Engineering;
3. A course in Architecture.

The Degrees of Civil Engineer, Mechanical Engineer and Architect, will be conferred upon Bachelors of Civil Engineering, Mechanical Engineering and Architecture, respectively, of this, or of any reputable college or university, who shall, upon examination, to be held not sooner than two years after attaining a first degree, show special proficiency in some branches of professional study, and shall present a satisfactory thesis.

There are 24 separate Departments of Instruction.

XVIII. INDUSTRIAL DRAWING.

(Professor Pike.)

Drawing and Descriptive Geometry are required of the Scientific students of the Collegiate Department, are optional with the Modern students during the entire course, and for the classical students during the first two years.

The course is as follows:

Sub-Freshman Class.—During the second term the students learn the use of the instruments and draw a series of plates of geometrical problems and elementary projections.

Freshman Class.—Projection Drawing is continued a part of the first term. This instruction is given by means of models and machines, each student making sketches and taking actual measurements from which the final drawings are made. Tinting and shading are then taken up, and, after a number of practical plates are made, are applied to one or more projection drawings.

Sophomore Class.—Descriptive Geometry is taken up during the second term, especial attention being given to perspective and isometric projection. In this, as in projection drawing, the work is done as far as possible from sketches and measurements taken by the students themselves.

The College of Mechanic Arts.

Object.—The aim of the instruction given in this college is to lay a broad and solid foundation in Mathematics, Mechanics and Drawing, so that with the practice in field, shop and office work, given to the students in the respective courses, they shall be fitted for immediate usefulness upon graduation, and after a moderate amount of subsequent practice and experience, be capable of taking charge of important works. * * *

There are fifteen lectures or recitations per week, besides daily exercises in drawing, field work or shop work and the rhetorical and other exercises.

Besides regular two years courses in Mechanical and Civil Engineering, in which drawing is required, there are the following additional courses.

III. ARCHITECTURE.

This course coincides with that in Civil Engineering, except as follows:

1. The drawing throughout the course is especially arranged for architectural work.
2. In the first term of the Junior year, history and orders of architecture are substituted for courses, leveling and earth work.
3. In the second term Senior year, lectures on decoration and color are substituted for lectures on motive power.
4. In the third term Senior year, the designs and specifications are those of buildings, instead of bridges, etc.

SPECIAL COURSES.

Besides these regular courses, two special courses have been established.

I.

A Course in Shop-Work, Drawing, etc. This college having fitted up shops for instruction in vise-work, forge-work and wood-work in connection with its course in Mechanical Engineering, is now prepared to offer instruction to young men wishing to become skilled mechanics, as follows:

First Term.—Vise-work, Mechanical Drawing and Mathematics.

Second Term.—Forge-work, Drawing and Mathematics.

Third Term.—Wood-work, Drawing and Mathematics.

This course is intended to give a thorough drill in the use of tools, teaching methods and processes common to different trades, and also a practical working knowledge of drawing, and such branches of mathematics as may be studied. Shops for instruction in the use of machine tools, in foundry work, etc., will be fitted up as soon as the new Mechanic Arts building is completed.

II.

An Evening course in Mechanical Drawing, intended for mechanics and apprentices who are unable to take the day course given above.

This course consists of twenty-five lessons, and for the year 1882–'83 will begin Monday, November 6th, 1882, at half past seven P. M. Those who have already received instruction in drawing will be given advanced work, while beginners will first receive instruction in geometrical and projection drawing, after which the work will be varied as far as possible to meet individual requirements.

METHODS OF INSTRUCTION.

Instruction in the several subjects pertaining to civil, and mechanical engineering and architecture, is given by text-books, lectures, reading in the general library and practical exercises, the theories taught in the class-room being applied in the solution of practical problems and the construction of original drawings. The students are also required to visit the various machine shops, bridges and important structures in the vicinity and make reports upon them, accompanied by sketches and necessary measurements. The students in Mechanical Engineering receive a thorough drill in the use of tools in a series of instruction shops, thus fitting them for superintending the construction of the designs which their training in class and drawing-rooms will prepare them for. Field practice is a portion of the regular course in Civil Engineering. The classes in surveying are drilled in the measurement of land already divided up, in the laying out of fields of given shape and

area, in the subdivision of land as practiced by the Government surveyors, and in the solution of various geometrical and trigonometrical problems from data taken by the students themselves. In railroad work the students have practice in laying out curves, taking levels, cross-sectioning, staking out—in fact, they do all the work of locating a railroad line, from the preliminary survey up to the point of actual construction. In topography the classes make a complete survey of a piece of land with diversified surface and make a finished drawing, showing the contour lines and all other details. In the drawing-room the students in the various courses receive thorough drill in making both working and finished drawings from plates, from machines and structures already built and from original designs of their own.

The Calendar for 1880–81, records a total attendance of 253 students.

The latest catalogue * at hand, shows for the decade that has passed since the above abstract was made, a most amazing growth; and is evidence that the University has kept step,—pari passu,—with the marvelous growth of the State in its increase in population and wealth, as the following extracts from the Historical statement testify:

The University dates its actual organization from an act of the legislature, dated February 18, 1868, which was entitled, "An act to re-organize the University of Minnesota, and to establish and Agricultural College therein." From that time until the present the growth of the University has been all that its friends could expect or wish.

With the opening of the year 1888–'89, two new departments, which up to that time had been purely theoretical, were made a reality by the opening of fully equipped departments of Medicine and Law. These departments have already proven their right to exist and the wisdom of the Regents in organizing them when they did, by the students which they have drawn and the character of the work done. It is not too much to say that no College of Medicine or Law has ever before reached so high a degree of usefulness and real merit in so short a time as the departments of Law and Medicine in the University of Minnesota.

The year of 1888 was also marked by the organization of a new department, which was an entirely new departure in the educational world. The School of Agriculture is the department which is referred to. It is sufficient proof of its success to point to other States which have adopted the same plan as solving the difficult problem of agricultural education.

Since that small beginning of 1868 the University has increased from seventy-two students, and these mostly of the preparatory department, until now we have nearly fourteen hundred. From one department we have increased to ten. From an institution struggling for bare existence we have grown until we are second to none in the facilities offered for the securing of a thorough education. From a part of a building poorly equipped, we have increased until now we have fifteen buildings, among them some of the best equipped laboratories in the world.

The "College of Mechanic Arts," has been reorganized and enlarged, and is now known as "The College of Engineering," as given below.

The following are the two large departments of the University in whose courses are found the studies germane to this Report:

The College of Engineering, Metallurgy and Mechanic Arts offers courses of

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* The University of Minnesota. Catalogue for the year 1891–'92, and Announcement for the year 1892–'93. By the University, Minneapolis, 1892. Pp. 182.

study in Civil, Mechanical, Electrical, Mining and Chemical Engineering, Architecture, and Metallurgy, leading to the following named Bachelor's degrees: Civil, Mechanical, Electrical and Mining Engineering; and also Architecture.

There is a School of Design, Freehand Drawing and Wood Carving, in connection with this college.

The College of Agriculture offers a regular college course in agriculture of four years of college work. The degree of Bachelor of Agriculture is granted upon completion of the course.

The School of Agriculture is a training school for practical farm life, and also for the College of Agriculture, if the student desires to pursue the subject further.

The Faculty of the College of Engineering number, beside the President of the University, 21 Professors, Associate Professors, Lecturers and Instructors, and one Engineer.

In this College there are seven regular courses of study, viz: Civil Engineering, Mechanical Engineering, Electrical Engineering, Architecture, Mining, Chemistry and Metallurgy leading to the corresponding baccalaureate degree.

Special students are admitted to pursue, under the direction of the faculty, one or two distinct lines of study selected from some regular course. Such students must be persons of mature years. "All applicants, as conditional to their admission as special students, shall pass an examination in so many of the subjects known as requisites for entrance to the regular course of study, as properly belong to or are naturally introductory to the line or lines of study they have elected."

There are two courses in practical mechanics to meet the wants of young men eighteen years of age and upward, who are unable to take a full course in mechanical engineering. The requisites for their admission are stated on another page.

There is also a school of design, freehand drawing and wood carving, whose object is to provide instruction to regular University students and to others desiring special instruction in ornamental design, freehand drawing and wood carving.

"The studies of Freshman year are the same in all the courses."

The courses in the several departments of engineering correspond to those in the best scientific schools of the country; and the college is well equipped with Laboratories, work shops and machinery, for their demonstration and practice. The courses in "Practical Mechanics", and the "School of Design", more directly connect the work of this University with that of the schools and instrumentalities recorded in the present volume of this Report; and illustrate, on the one hand, how the connection is made between the elementary work both in Industrial Art Drawing, and in Manual Training, as given in the common schools, and the higher training of the University; and, on the other hand, show how the impulse for adding art knowledge to industrial production, has begun to permeate the community; since it has led this State University to provide a special school for such instruction.

The courses in Mechanical Engineering and the equipment for instruction in these courses are thus shown:

MECHANICAL ENGINEERING.

The work of this course may be divided into three principal lines; theoretical engineering, experimental engineering, and manual training, or the Mechanic Arts.

* * * * * * *

In manual training the student receives practice in free-hand drawing, shading, lettering and sketching parts of machines; also correct ideas of mechanical drawing.

The shop work in this department aims to make the student well acquainted with the methods of modern manufacturing establishment, and, at the same time, to acquire skill in the processes.

The Wood-working and Pattern-making course is intended to embody a certain application of certain tools and methods to the work, continued by the construction of patterns for parts of machines. This is supplemented by instruction in the moulding and founding of these parts in brass and iron.

In the forge shop the student is instructed in welding, forming various shapes in iron, and in the making and tempering of hand and machine tools. The instruction in the machine shop will give the student familiarity with the tools and operations of the modern manufacturing machine shop, by the construction of parts or the whole of a machine and the making of machine tools.

* * * * * * *

The Shops.—The basement of the Mechanics building is occupied by the mechanical laboratory, machine and vice shop, and wood working shop; the wing by the engine and boiler room, forge shop and foundry.

These shops are equipped with tools which represent the best American practice. Each shop will accommodate from ten to twenty students at a time.

The instruction given is based on the "Russian System," in which the leading idea is to teach principles rather than to produce objects of commercial value. It is believed that the greatest progress can be made in a given time by this method, as the student proceeds, by a carefully planned series of exercises, from the simplest to the most difficult operations, learning the process but avoiding the repetition of the ordinary shop. So far as is consistent with this system the work is adapted to parts of some machine or structure in common use, and after finishing the exercises referred to above, the class will build some complete machine or structure, as a review and application of the preceding work.

Shop work is required of students in mechanical and electrical engineering, in division A and B of the special courses in Practical Mechanics, and carpentry is required of students in architecture and civil engineering.

The engine and boiler room is provided with an automatic cut-off engine of modern type, capable of developing thirty-five horse power. A steel boiler of ample size, furnished with a feed pump and heater, supplies a steam.

The machine and vice shop contains a speed lathe, ten engine lathes of various sizes, a planer, shaper, universal milling machine, vertical drill press, emery tool grinder, a Brown & Sharp cutter and reamer, grinder, grinding attachment to lathe, benches with ten vice, surface plates, a set of Belt's standard gauges, taps, dies, reamers, drills, chucks, and other hand tools and accessories for practice in machine, tool and vice work. It contains the milling machine and a tool lathe.

The shop for pattern making and general wood work contains benches with vices and tools, lathes and lathe tools, an improved universal sawing machine for pattern making, etc., a jig saw, planer, boring machine, grind-stone, and other tools for use in the courses in carpentry and pattern.making.

The forge shop is provided with a portable hand-forge, stationery forges with anvils and sets of tools, a blower, exhaust fans, hand drill press, drills, taps, dies, sledges, swages, a grind-stone and other tools generally in blacksmithing.

The foundry contains an eighteen-inch cupola brass furnace, core oven, moulding tools, benches, ladles, crucibles and all of the tools and material ordinarily needed in moulding and casting iron, brass or white metal.

Regular students pay a fee of three dollars for each term of shop work.

Drawing Rooms.—The general drawing room is furnished with drawing tables for the use of classes in geometrical drawing. A considerable collection of prints,

drawings and models, including a full set of Schroeder's models for descriptive geometry has been made. Two engineering drawing rooms contain tables, cases, etc., for students in advanced work in all the courses of study comprised in this college.

Adjoining the drawing rooms are "blue print" and dark rooms fitted with complete apparatus for duplicating drawings by the "blue print" process and for photography.

Another dark room exclusively for photographic work has been fitted up on the first floor.

Rooms in Pillsbury Hall are equipped with a constantly increasing collection of papier mache models, drawings and charts for use in the instruction in freehand drawing.

The following statement of the course in practical mechanics shows how in this State University, just as, for instance, in the Spring Garden Institute Schools, in Philadelphia, the practical training of industrial workers is undertaken.

Practical Mechanics.—Two courses in Practical Mechanics have been established in connection with the Department of Mechanical Engineering, to meet the wants of mechanics. They are:

A. A two years' course in shop work, drawing, mathematics and applied mechanics for young men unable to take the full course in mechanical engineering and for those wishing to prepare themselves for positions of trust in shops and factories.

B. A one year's course in the care and management of engines and boilers, intended as a preparation for the examinations of the State Boiler Inspectors and to fit students for the care of steam plants.

Admission.—Applicants for admission to either course must be at least eighteen years of age, and must pass examination as follows:

A course: Algebra, Plane and Solid Geometry as for the regular Freshman class. English Grammar and Composition—a practical examination in the use of English.

B course: Arithmetic, including square root and compound numbers, English Grammar and Composition, as for A Course.

A course.

FIRST YEAR.

First Term.	Second Term.	Third Term.
Carpentry [7]. Drawing [5]. Higher Algebra [5].	Pattern Making [7]. Drawing [5]. Trigonometry [5].	Foundry Work [7]. Drawing Machine Details [5]. Mechanics [5].

SECOND YEAR.

Vice and Machine Work [7]. Mechanism [5]. Engines and Boilers [5].	Forge Work [7]. Mech. Laboratory [5]. Drawing Machine Details [5].	Machine Work [7]. Indicators and Engine Tests [5]. Drawing (Designing) [5].

B course.

First Term.	Second Term.
Recitations and lectures on the principles and care of engines and boilers [5]. Drawing [3]. Engine running [5]. Forge, Vice and Machine work [5].	Indicators and engine tests [5]. Drawing (engines and boilers) [5]. Engine running [3]. Machine work [5].

The instruction in shop work is given by means of carefully prepared exercises. These exercises are planned wholly with the object of instructing the students in the use of tools, leaving out the idea of construction, except in so far as it may not interfere with instruction.

The drawing is conducted on the same plan as in the engineering course, the students first using the text book and afterwards varying their work to meet their individual requirements. Thorough drill is given in applied mechanics, mechanism, and simple machine designing, thus giving a two years' course in mechanical engineering, avoiding as far as possible the use of the higher mathematics.

The instruction in the B Course in the care and management of engines and boilers is given by the means of practice in the engine room, under the immediate direction of the engineer. Students in this course are required to keep record on suitable blanks of the work done by the engine, and of the fuel, water and oil consumed, and to figure on the cost and relative economy of various fuels and methods of running. The reasons for the regulations, as laid down for running, are explained, and the principles of the steam engine and of the construction of boilers are given in a manner not difficult for one of ordinary intelligence to understand; and finally, tests of engines and boilers are given.

While the direct interests of industrial workers are cared for in the course just described, the artistic interests of the University students in general, as well of those who may wish to become workers in the art industries, are cared for in the following department:

SCHOOL OF DESIGN, FREEHAND DRAWING AND WOOD CARVING.

The object of this school is to provide instruction to regular University students, and to foster and encourage a taste for and knowledge of industrial art among others desiring special instruction in ornamental design, freehand drawing or wood carving.

A two years' course in Wood Carving and Design, a two years' course in Freehand Drawing, and a two years' course in Ornamental Design are here outlined.

Wood Carving and Design.

FIRST YEAR.

First Term.	Second Term.	Third Term.
Drawing simple conventional forms. Carving these forms in low relief. Care of carving tools.	Drawing from cast. Elementary study of historic ornament. Modeling from casts. Wood finishing.	Surface Carving. Study of natural plant forms. Elementary conventional design. Carving from original designs.

SECOND YEAR.

First Term.	Second Term.	Third Term.
Study of the fundamental principles of design. Elementary original composition. Carving in intaglio.	Advanced design. Study of light & shade in crayon. Carving in high relief. Modeling in clay.	Study of historic ornament. Original composition. Advanced carving in high relief.

Freehand Drawing.

FIRST YEAR.

First Term.	Second Term.	Third Term.
Outline drawing from geometric solids and other simple forms.	Cast drawing in outline. Elementary freehand perspective.	Elementary study of light and shade, from the cast in pencil and crayon.

Freehand Drawing—Continued.

SECOND YEAR.

First Term.	Second Term.	Third Term.
Drawing from casts of historic ornament and architectural details. Out of door sketching.	Elementary study of the antique in outline, and light and shade in charcoal and crayon.	Study of the full length figure, and animal forms from nature and the cast, in black and white and sepia.

Ornamental Design.

FIRST YEAR.

First Term.	Second Term.	Third Term.
The anatomy of pattern. The planning of ornament. Analysis of plant forms.	Original designs in outline from given motives, in flat, "all over," conventional treatment.	Elementary study of historic ornament. Flat treatment of foliage from nature, in colors.

SECOND YEAR.

Original colored designs for walls and ceilings. Sepia and water color work from nature.	Designing for prints, book covers, relief work, etc. Original designs in historic styles.	Designs for stained glass and woven fabrics. Studies from nature in color.

The courses are as thorough and comprehensive as possible within the limit of the time specified, and are carefully outlined with a view to the harmonious cultivation and uniform training of the eye, the hand and the mind to work together for the best results. Instruction in landscape drawing will be given to advanced students.

Applicants for instruction in Ornamental Design are required first to possess a knowledge of drawing equivalent to one year's work in the drawing course outlined above; which can be taken here (if not previously acquired) before commencing work in the course in Design.

In the course in Ornamental Design, instruction is first given in the elementary principles of original composition, in their relation to natural growth, as applied to decorative art, with the intention of fostering originality of thought and individuality of expression. Students learn from the beginning to produce their own designs in both natural and conventional form, and when they are thoroughly conversant with the principle of natural growth, and when simple forms can be rendered with grace and feeling, the study of historic ornament in relation to different art periods will be introduced, embracing the Egyptian, Greek, Roman, Byzantine, Gothic, Renaissance, etc., with their practical application to the construction of original ornament.

Instruction is given in the theory and application of color to printed and woven fabrics and, when able to do advanced work, students are placed in direct communication with manufacturers with whom there is a constant demand for good original work and for which remunerative prices are paid.

In the foregoing special studies each student will be advanced as rapidly as his or her individual talent and perseverance will permit.

Illustrated lectures are given on the principle of Delineation, Original Ornamental Design, Wood Carving, etc.

Applicants for admission to either course in this school must be at least fifteen years of age.

There is, also, in this College, a School of Architecture; an account of which will be given in connection with those of the other schools of architecture, elsewhere in this Report.

In the programme of courses and studies in the College of Agriculture, Drawing does not appear by name; though in The School of Agriculture, Manual Training is one of the required subjects through Freshman year, in which course, from the following statement, it appears that drawing enters to some limited extent.

SHOP WORK AND DRAWING.

Instruction is given by means of text-books, lectures, and work in the shop and drawing room in the care and use of tools, including setting and filing saws, filing bits, grinding plane-irons, chisels, and other tools; also in laying out work, framing rafters, braces, stairs, etc.

Methods of construction are illustrated with models and drawings.

Various articles for use about the farm are manufactured by the students.

Designs are made for dwellings, barns, out-buildings and machinery.

Estimates are made of the amounts of material and the cost of construction.

The summary of students shows a total attendance during the year 1891–'92, of 1,374; of whom 291, were women.

The "College of Engineering, etc.," has 197 students; 44 of these are in the School of Design, and 35 of them, are women. The "School of Practical Design," has 45 students, all men. The "College of Agriculture," has a total of 132 students, all men. "The Faculty and Instructors" of the University number 121. There are 6 other officers. Cyrus Northrop, LL. D., is the President.

CHAPTER XI.

UNITED STATES LAND GRANT COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS—Continued.

ANALYSIS OF CHAPTER.

Agricultural and Mechanical College of Mississippi.

The Agricultural and Mechanical College of Mississippi, situated near Starkville, is the successor of "The College of Agriculture and the Mechanic Arts," which was originally a department of the State University at Oxford. That department was organized in 1872, in accordance with the United States Law of July 2, 1862, granting land for the establishment in each State of one or more "Colleges of Agriculture and the Mechanic Arts."

By act of the Legislature, the income arising from this Land Grant fund was at first divided between the State University, and the Alcorn University, the latter an institution for colored students, in the ratio of two fifths to the State University, and three fifths to Alcorn. Subsequently, by act of 1875, the interest of this fund was equally divided between the two Universities.

In 1878–9, the Legislature chartered the "Agricultural and Mechanical College," and transferred to it that portion of the interest on the Land Grant fund which had, heretofore, been given to the State University.

This new Institution was organized in obedience to the directions prescribed to the Trustees, by the original act of the State Legislature, in accepting the endowment fund from the General Government; which directed

> The establishment and maintenance of a first-class institution, at which the youth of the State may acquire a common school education, and a scientific and practical knowledge of agriculture, horticulture and the mechanic arts, also the proper growth and care of stock, without, however, excluding other scientific and classical studies, including military tactics.
>
> They shall regulate the course of study, rates of tuition, management of experimental farm, manner of performing labor, and the kind of labor to be performed by students.

As defined in the announcement in the catalogue of the "objects" of the College, the education is designed to be practical and industrial; "to educate and direct the minds and tastes (of the students) to agriculture, horticulture, care and growth of stock, management of farms, manner of performing labor and the mechanic arts. The College is not to be in the strictest sense either literary, classical or military; but rather a college intended for special technical training, in agriculture and the Mechanic Arts."

The college is situated on a farm of 840 acres, near the town of Starkville, Oktibbeha county, on a branch line of the O. and M. Railroad. Suitable buildings were erected and the farm stocked.

> They have provided for a preparatory and Collegiate course, which will afford the youth of the State ample means of acquiring a thorough elementary education, and a scientific and practical knowledge of Agriculture and the Mechanic Arts.
>
> The College opened October 6th 1880; 354 students from all sections of the State have matriculated during the session.

Drawing is taught in the third term of the Freshman and Sophomore classes.

DRAWING.

Free Hand.—Walter Smith's Intermediate Course is used as a text-book, supplemented with practice in drawing leaves and parts of plants, insects, etc.

Geometrical.—Use of drafting instruments, mounting paper, projection, isometric, perspective, working plans of farm buildings, etc. Students will be required to present an original plan of farm house or barn at close of course.

The catalogue for 1880-'81, shows a preparatory class of 267, Freshman class of 73, and a Sophomore class of 14.—

The latest catalogue* at hand, announces the recent opening of the "Department of Mechanic Arts," which addition to the educational facilities of the College, is a decided departure in the direction of the new movement now going on throughout the United States, and chronicled at such length in the present Report.

The annual income of the College, arising from the 6 per cent Bonds which represent in the State Treasury the U. S. Land Grant, is nearly $5,000. Fifteen thousand dollars of the principal was authorized by the Legislature to be expended in the purchase of the land. The youth of the State are entitled to remain for four years at the College without paying for tuition. Rooms are also furnished free. Students from elsewhere, and citizens in excess of the term of four years, must pay such sums as the Trustees may determine. The College is under military discipline and all students must wear the uniform.

The following extracts are from the statement of the "Objects and History of the College."

The College is on a permanent basis, the Legislature having made ample provision for both agricultural and mechanical instruction, both in theory and practice. There are now provided two courses, one in agriculture and another in the mechanic arts, both leading to the degree of Bachelor of Science in the collegiate department. The farm, creamery, stock barns and sheds, gardens and orchards, and shops for instruction in wood and iron and foundry work, being ample for practical training.

The Trustees have established a Preparatory and Collegiate course, which will afford the youth of the State ample means of acquiring, in accordance with the law, a thorough, elementary education, and a scientific and practical knowledge of agriculture and the mechanic arts.

The large number of students in attendance each year shows that the College supplies a long felt want to the people of the State by giving a thoroughly practical education to its youths. It is evident that a large class of our people desire the young men of the State to combine manual labor with literary instruction; and this is a correct idea where boys are to be educated for industrial pursuits. Training of this kind should be in connection with farm and shop work, where industrious habits may be preserved, or where such habits may be acquired by those not having them already. Study for four years without the habit of manual labor cre-

* Twelfth Annual Catalogue of the Agricultural and Mechanical College of Mississippi. 1891, 1892. Post Office, Agricultural College, Miss. Telegraph and Express Office, Starkville, Miss. Announcement, 1892-1893. Vicksburg, Miss. Commercial-Herald Print. 1892. Pp. 62.

ates a disinclination for such work, and tends to separate brain work and hand work, giving discredit to the latter.

The development of our agricultural and mechanical interests necessitates that theory and practice go together in the education of the farmer and mechanic. If this is true of the other professions, why not of the farmer's? The labor feature corresponds to the technical and expensive instruction that is given at West Point and Annapolis in the numerous drills, encampments, cruises, etc.,—to that given in the hospitals and dissecting rooms of medical colleges—in the moot courts of the law school, and in the field work of the engineer.

The instruction in the academic and scientific departments is of the highest importance, and nothing can take precedence over it. The industrial feature comes next, and with it is joined the pecuniary assistance which a student can obtain by his work. It differs from that of the old manual labor school in this: There, the important matter was to work enough to pay all expenses; the education received was of secondary consideration compared with earning enough money to pay one's way. The boy who labors most of his time is physically too tired to accomplish much in his studies; whereas moderate labor facilitates study. It is desirable that this feature should be understood in connection with the College. It must not be thought that a boy can work his way through by his labor, and also get a first-class education. It is impossible to do both. He could not accomplish both if he had a school at his very door. A student here has many advantages; he not only gets his tuition free; but he has an opportunity to work and pay for part of his board by his own labor. At home he would still have to incur the expense of board and clothing—an expense unavoidable in attending school under any conditions.

In the Preparatory Department "Mechanical Drawing" and "Workshop Principles and Methods" are required studies.

The Mechanical Department, now fully organized, furnishes a valuable addition to the course of study. By skilled workmen, trained for such teaching, the students are taught the selection, care and use of tools designed for wood work. Frequent practice in the shops will develop skill of hand and accuracy of observation, resulting in such a love for this work on the part of many, as will, perhaps, lead to their adoption of it as a vocation in life. Shop practice is carried on in the afternoons, alternating with work in the field and garden.

In the Agricultural course of the College, Drawing is a required study during the first terms of Freshman and Sophomore years.

In the new "Mechanical course", Drawing and shop work are taken in place of the technical agricultural training, otherwise the studies are alike. The following statement shows the equipment for the new course and the special work in drawing required.

Mechanic Arts.

Harry Gwinner, *Superintendent.*

This department was opened for the reception of students September, 1891.

A substantial building 50 feet by 100 feet, was erected in May, 1891, and has been fitted up for a thorough course in carpentry, and wood turning.

The Mechanical Course is designed to afford such students as have a common school education an opportunity to continue the elementary, scientific, and literary studies, together with free hand and mechanical drawing, while receiving theoretical and practical instruction in the various mechanic arts, leading to the degree of Bachelor of Science.

The training here given does not endeavor to train a single set of faculties, but to develop harmoniously all the powers.

It proceeds upon the principle that the eye and hand should be educated no less than the brain.

On account of the limited time spent in the shops it is impossible to turn out skilled mechanics, but what the student receives there not only gives him the best practical ideas, but teaches him that manual labor is no more degrading than intellectual labor and equips him in such a manner that he will experience no difficulty in selecting the trade that is best for him to pursue.

The Legislature has appropriated an amount sufficient for the erection of a one-story building, 35 feet by 70 feet, which will be used for a forge shop and foundry.

A portion of the building now used for instruction in wood work will be used for machine shop work.

The instruction in shop work consists of a graduated set of exercises so planned as to cover the operations in use in the various trades, and each exercise will cover as much ground as possible in order to avoid undue repetition.

There are twenty double benches in the wood-working shop each of which has a complete set of tools.

The first instruction in carpentry and joinery, is in the use of the saw and plane in working wood to given dimensions; and a series of elementary exercises follow in order, such as practice in making square joints, different kinds of dove-tails, the various tenons, roof trusses, etc.

Wood turning and pattern making succeeds the work at the benches, and subsequently, the student will make castings from the patterns made while in the wood shop.

The foundry will have twelve benches to be used by the students in mixing sand and making moulds, and the castings made from these moulds will be used by him in his vise work.

The foundry will also contain a cupola, brass furnace, and core oven.

The forge shop will contain twelve forges with anvils for same, and all necessary tools. The blast for the forges and cupola, will be furnished by a 24-inch blower and all smoke will be taken from the shop by an exhaust fan.

The work in the forge shop will include the management of the fire, drawing, forming, bending, upsetting, splitting, punching, annealing, tempering, and case hardening.

The machine shop will have an equipment of six engine lathes, two speed lathes, one planer, one drill press, one shaper, six vises, and a full assortment of taps, dies, and files.

After the construction of the lathe has been fully explained to the student, he will be taught centering, turning, chucking, reaming, outside and inside screw cutting, and will also receive instruction on drill press, planer, shaper, and vise. He is then required to construct some piece of mechanism in which many of these principles are involved.

The motive power is furnished by a forty-horse-power engine, and each week a student will be placed in charge of the engineer, and in this way will learn the care and management of the boiler, engine, and pump.

All work is done from scale drawings made in the school and furnished to each student.

DRAWING.

Drawing extends through the entire four years, and is looked upon as of the highest importance and the effort is to make the instruction thorough.

In the Freshman Class, drawing from copy and lettering will be given. This takes up the copying, direct from drawings, which will be used until the copy is finished.

The lettering consists of instruction in letters of all styles, and the methods of figuring and marking drawings.

Later, the work will be orthographic projections and drawings of parts of machines and wood work, which will be used in the shop.

Sophomore Class.—In this year the work will be drawings of the construction of frames, joints, walls, etc., in architectural work and floor and foundation plans laid out. Instruction will be given in the representation of flat and curved surfaces by means of colors, and also of the materials used in engineering work.

Problems in descriptive geometry will be taken up and explained.

Junior Class.—Drawings will be made of epicycloidal and involute gear wheels and racks, pin and bevel gearing, and cams.

Work will be done on problems of power, transmission by shafting, belting, etc.

Senior Class.—The first part of this year the work consists of the designing of steam engine valves, and valve mechanism.

Later, time will be devoted to thesis work, and the student will work on such drawings necessary to show his particular design.

The mechanical buildings are always open for inspection and visitors are always welcome.

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All students taking the Mechanical course are required to work four to eight hours per week in the shops. As this labor is educational no pay is received for it. For all other labor faithfully performed they are paid eight cents per hour.

The total attendance numbers 310; of these, 125 are in the Preparatory Department. The Faculty numbers 18 Professors and assistant Professors. Gen. S. D. Lee is the President.

Alcorn Agricultural and Mechanical College, Miss.

The Alcorn Agricultural and Mechanical College, formally known as The Alcorn University, occupies the site of Oakland College, which was bought for the new University when it was established in 1871.

The University received three-fifths of the annual income from the United States Land Grant fund for the establishment of "Colleges of Agriculture and the Mechanic Arts," the State University received two-fifths, until the ratio was changed by the Legislature, in 1878, and the annual income from that fund was equally divided between the two Universities.

The college is situated in Claiborne County, four and one-half miles northeast from Rodney, on the Mississippi River. There are suitable buildings and the farm consists of 295 acres of diversified land, "well adapted to the various purposes of a model or experimental farm."

In the regular "Scientific Course" of the University, Free-hand drawing is taught each term of Freshman year; after which, drawing does not appear in the schedule of studies. In the "Special Scientific Course in Mechanical Engineering," Drawing is required through the third term of Sophomore year; "Shading, Tinting, and Drawing from Patterns," in the first term of Junior year, and "Drawing from Actual Machines," and "Designs of Machines," are required studies in the third term of Senior year.—The catalogue of "the Alcorn Agricultural and Mechanical College for 1880–'81, gives only three

courses of study: The "Agricultural," "Literary," and "Preparatory." Drawing is not a required study in the "Preparatory," and only appears as "Free-hand Drawing," in the first term of Freshman year in the other two courses.

There is a total of 148 students.—The catalogue for 1880-'81, does not show the course, or year, of the student, the names of all being simply arranged alphabetically; so it is impossible to ascertain how many are in the Preparatory, and how many in the College, classes.

The latest catalogue* has several interesting and original features, and is, in its classification of students, certainly superior to the one from which the foregoing abstract was taken; in that the list of pupils shows both the class, and the department, in which each one is enrolled. In addition to the four college classes, there are "Junior" and "Senior" "Preparatory" classes, and a "Sub Preparatory" class, which last has by far the largest attendance. There is a Preparatory "Academic course" of three years; and a "Scientific Preparatory Course" of two years. In the detailed course of study given for all the departments, Drawing is required during each term of the first year in the "Scientific Preparatory Course." No mention of this study is found in any other department. The following statement, however, shows that some technical industrial training is to be given, in addition to the opportunities for work on the farm.

The Carpentry and Painting Departments were opened up last September, and thirty odd students received instruction during the year in the former, while eight were taught in the latter. The Blacksmith Shop will be ready for apprentices in September next.

The attendance has reached the limit of the accommodations and a new Dormitory building is planned. The frontispiece shows a number of two story houses, with pleasant porticoes and galleries, set in a line, on a pleasantly shaded campus.

GROUNDS.

The grounds, comprising something less than 300 acres, with the exception of some 30 acres, more or less not under fence, are about thus divided: 70 acres in the campus, 80 under cultivation, and most of the rest furnishes a very good pasture for the stock.

The history and resources of the College are thus set forth:

"Oakland College" was founded in the interest of the Southern Presbyterians in 1828. The grounds and buildings were sold in 1871, when the State became the purchaser, and dedicated the same, under the name of "Alcorn University," to the higher education of her colored youth. In 1878, the Legislature reorganized the school under the name, "Alcorn Agricultural and Mechanical College," the better to comply with the Act of Congress of July, 1862.

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* Catalogue of the officers and students of Alcorn A. & M. College, Westside, Miss., 1891-1892, and announcement for 1892-93. Jackson, Miss.; The Clarion Printing establishment. 1892. Pp. 26.

The Agricultural Land Scrip Fund, donated by the United States Government to this State, had increased to $227,150, when the Legislature, in 1878, divided it equally between the Agricultural and Mechanical College at Starkville and this College, giving to each $113,575, the interest on which is $5,678.75 per annum.

All necessary expenses over and above that amount have heretofore been provided for by legislative appropriations.

By Act of the Legislature of 1892, the annual expenses of the College for the next two years will be provided for thus:

Interest on Congressional Land Scrip	$5,678.75
State appropriations	2,321.25
Total	$8,000.00

In addition to the above, the Legislature granted an especial appropriation of $2,000, to be used in repairing of buildings, etc.

An additional appropriation of $8,000 was granted by the Legislature to provide more dormitory and recitation rooms.

By an Act of Congress known as the New Morrill Bill, which became a law August 30th, 1890, and entitled "An Act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts, established under the provisions of an Act of Congress approved July 2d, 1862," each State and Territory received $15,000 from the National Treasury for the year ending June 30th, 1890, received $16,000 for the year ending June 30th, 1891, etc., upon condition that in States requiring separate schools for white and colored children, an equitable division of the part received by said States, shall be made for the agricultural and mechanical education of the children of the two races.

Under that clause of the Act which provides: "That payment of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of the Legislature meeting next after the passage of this Act, shall be made upon the assent of the Governor thereof, duly certified to the Secretary of the Treasury," the first two payments received by Mississippi have been divided equally between the A. and M. College at Starkville, and Alcorn A. and M. College.

Hereafter this institution will probably receive something over $10,000 annually from this source.

As to how the new Morrill Bill Fund may be used, the following, taken from a circular letter sent out by the Commissioner of Education, dated January, 1891, and addressed to Presidents of State Colleges of Agriculture and the Mechanic Arts, etc., will show:

"In this connection, your attention is respectfully invited to the limitations placed by the act upon the use of the money received, which is to be applied only to instruction in Agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural and economic science, with special reference to their application in the industries of life, and to the facilities for such instruction. It is held by the Secretary that this language authorizes, besides the payment of salaries, the purchase from this money of apparatus, machinery, text-books, reference books, stock and material used in instruction, or for purposes of illustration in connection with any of the branches enumerated."

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Tuition is free to all Mississippi students, but to all others it is $15 a year in advance. Each student, on entering, will be required to pay a doctor's fee of $2.00, which will entitle him to medical attention during the school year; 50 cents additional will be charged for medicine. Board may be had at the Refectory, at $6.50 per month, in advance. This includes table-board and washing.

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By working on the farm, or in the shops, as it is needed, most any student can earn about a third of his expenses.

The last two pages of the cover are so utilized as to add to the interest and usefulness of the catalogue. On the outside page is a calendar of the scholastic year 1892–'93. The inside page is given half, to concise statements of "Things worth knowing by every Mississippi Farmer;" and half, to a list of books for general reading; which last, as it must needs be suggestive as to the trend of this educational movement among the colored people of Mississippi, and so can hardly fail of interest, is here quoted at length:

Students and others have so frequently asked for a list of the best books to read that the following list is given, not as containing all the best books but as presenting a number of good books from which a person fairly intelligent may select what he or she is able to purchase, according to the special object in view:

A Reference Bible with Maps. A Bible Dictionary. A Concordance. A Dictionary. An Atlas. Bunyan's Pilgrim's Progress. D'Aubigne's History of the Reformation. Ten Acres Enough. Elements of Agriculture. Page's Theory and Practice of Teaching. Sweet's Method of Teaching. Self Help, by Smiles. Ten Nights in a Bar Room. History of Civilization, by Guizot, Redpath's Popular History of the United States. Titcomb's Letters to young People. Bacon's Essays. Locke's Conduct of the Understanding. Green's Short History of the English People. Sketch Book, by Irving. Utopia. Rasselas. Don Quixote. Gibbon's Decline and Fall of the Roman Empire. Uncle Tom's Cabin. Last of the Mohicans. The Black Phalanx. Men of Mark, by W. J. Simmons. Rights of a Citizen of the United States, by Theo. Parsons. Everybody's Lawyer. Pryde's Highways of Literature. Addison's Spectator. Arabian Nights. Vanity Fair. Adam Bede. Dante (in English.) Robinson Crusoe. David Copperfield. American Humorist. The Poems of Shakespeare, Milton, Whittier, Bryant, Longfellow, and Sir Walter Scott. Manual of Co-operation. The biographies of such Americans as Chas. Sumner, President Lincoln, President Grant, Henry Clay, Benjamin Franklin, George Washington, etc.

The total attendance is as follows:

RECAPITULATION.

Number enrolled in College Department	47
Number enrolled in Preparatory Department	50
Number enrolled in Sub. Preparatory Department	179
Total enrollment	276

The Governor and Treasurer of the State are, "ex-officio," members, and the Governor is the President, of the Board of Trustees.

Ten Professors and Instructors comprise the Faculty. John H. Burrus, M. A., is the President.

The University Of The State Of Missouri, Columbia, Missouri.—The College Of Agriculture And The Mechanic Arts.—The School Of Mines And Metallurgy.

The income of the United States Land Grant is divided in Missouri, between two Departments of the State University; which has most of its Departments at Columbia, Boone County. "The Departments which receive the benefits of the Land Grant Fund, are the Agricultural College", situated at Columbia; and the "School of Mines and Metallurgy", situated at Rolla, Phelps County.

The "Professional Schools" of the University are nine, viz: "Agriculture, Pedagogics, Law, Medicine, Mining and Metallurgy, Engineering, Military Science and Tactics, Art, Commercial."

The course in Agriculture has been reduced to two years, Mechanical Drawing is taught in the first half of the last year. There were 21 students in 1881–'82.

The school of Engineering includes four courses, "Civil Engineering" "Topographical Engineering," "Surveying and Astronomy" and "Military Engineering."

Drawing is of necessity an important study in all these courses, modified somewhat in each to suit the needs of the special course.

In the report to the President of the University for the year ending June 1st 1882, the Dean of the Faculty says:

"Drawing has been made a more prominent feature of the course; and Warren's entire series of engineering drawing books is now used as the text. McCord, on Mechanical Drawing and Smith on Topographical Drawing, are also used as texts." 42 students were in attendance in the School of Engineering during 1881–'82.

The School of Art and Drawing had a course of three years. A total of 140 students of the University, are enrolled under this school for 1881–82. The total number of students attending the University for this year was 509. There were, in addition, 82 students in the School of Mines at Rolla, making the total number of University students 591.

The latest catalogue* at hand has as frontispiece, a view of the stately main building intact; and opposite, a view of the same building in ruins, as left by the destructive fire of January 9th, 1892. The majestic Ionic columns, and the roofless massive walls, all jagged and corroded by the devastating flames, suggest rather the ruined monuments of Italy and Greece, than any modern constructions. The ruins, in fact, in these views, seem grander and more impressive than did the uninjured structure.

The University was created by the law of February 8th, 1839. The site in Columbia, selected June 24th of the same year, and the completed building was opened for academic purposes April 14th,

* Catalogue of the University of the State of Missouri. Fiftieth Report of the Curators to the Governor of the State. 1891–1892. Pp. 149. I. II.

1841. "The College of Agriculture and Mechanic Arts, and the school of Mining and Metallurgy, were made a department of the University by act of February 24th, 1870."

In the Report made by the Curators to Governor Francis, "for the year ending June, 1892",—after the expression of their gratification in having secured the year before, the acceptance of the Presidency of the University by Professor Richard H. Jesse, of Tulane University; whose administration thus far, they pronounce a great success,—the present prosperity and future prospects of the University are thus set forth:

The popularity of the work of the University, and its signal success, as evidenced by the increased attendance at this session, is matter of pride, not only to the management, but also to all the people of the State. Missouri, now more than ever, is devoted to the interests of higher education. The hearts of the people beat in unison with the desire for a grand institution of learning that shall give unexcelled power for development and progress, and shall be their crowning glory in the Mississippi valley. They have lifted the University to its legitimate legal status of the first institution in the State. They have made it the State University. They have entered upon the policy of endowing it, and they recognize their duty and interest to maintain it liberally and suitably. They, therefore, have a right to expect an expansion proportionate to the effort being made. Such has been the case. The growth of the institution in every respect is encouraging. The number of students at this session is 631, being 51 more than any previous year of the fifty-three years of the University's history; and in our opinion, but for the burning of the main building in the midst of the session, the number of students might easily have reached 700. With a continuance of the present vigorous policy by the State and the University itself, when the new buildings are erected and properly equipped, there appears to be no reason why the student corps should not in a brief time attain to twelve or fifteen hundred. The State of Missouri, by her situation and natural advantages, with the noble character and public spirit of her people, deserves this splendid accomplishment, and it is the ambition of all connected with the immediate control of the University to attain this end. Missouri should never pause for a moment in her onward movement, until none can mention her name or celebrate her glories without giving first thought and consideration to her great University. For at last it is great minds that most adorn a state, and elevate it far above the grandeur, fruitfulness and beauty of nature in the achievements of history and permanent beneficence of true glory. All experience carries this testimony. Intelligence discounts nature. A country is known by its men. The university is the creator of power—the power of thought—and elevated thought is the inspirer of sublime conduct. A country without great schools is incapable of lofty enterprise, and buries its annals with its years, leaving neither name nor memories to redeem it from oblivion.

An historical statement of the founding of several departments in their order of installation, is given as follows; and the opening in 1891, of the new school of Mechanic Arts, thus announced:

ACTS OF CONGRESS JULY 2, 1862, AND AUGUST 30, 1890.

By the land grant act of the United States of July 2, 1862, the equivalent of 330,000 acres of land was donated to the State for the purpose of establishing an Agricultural College, embracing instruction in agriculture, military science and tactics and the mechanic arts. It was intended that the proceeds of this grant should be used only for maintenance, and that the State should supply the buildings and equipment. The State, by act of the General Assembly, accepted this trust

and assumed entire control of the trust fund. By act of the Legislature of February 24, 1870, the Agricultural College, with the School of Mines and Metallurgy, was established as a department in the University. At a later period the Military department was developed, and under the patronage of the State, and presided over by able and accomplished officers of the United States army, detailed by the Secretary of War, is most successful. In this the design of the United States has been fully accomplished.

But the School of Mechanic Arts has been for nearly thirty years wholly neglected by the State, it having made no provision whatever for its institution or support. But by act of August 30, 1890, the United States Congress made further and liberal provision for the Agricultural College. This act yields an annually increasing amount from $15,000 in 1890 up to $25,000 when the latter sum became a fixed annual income. Of this amount Lincoln Institute receives a part, in the ratio of the colored children to the white children of the State. The School of Mines at Rolla, as a part of Agricultural College, receives 25 per cent. and the remainder goes to the Agricultural College at Columbia. By means of this unexpected income, without any aid from the State, the Board have been enabled to establish and put in operation in the Agricultural College at Columbia the Normal department, the Commercial department, the Department of History and Political Economy, and also a

SCHOOL OF MECHANIC ARTS; OR, MANUAL TRAINING SCHOOL.

This latter deserves an emphatic notice. It is an entirely new feature in university work. The first Manual Training School established in the United States was due to the thought of Dr. C. M. Woodward. It is a part of Washington University, at St. Louis, and he is its present Dean. The fame of that school is national, and Dr. Woodward is everywhere recognized as the originator of the system. As a member of the Board of Curators, he has taken a deep interest in the organization of the Manual Training School in the University. This in itself is a guaranty of the very best form. And he has stated that it is as well equipped and ably conducted, so far as developed, as any school of its kind in the country.

On the 3d day of June, 1891, Prof. C. W. Marx was elected by the Board Superintendent of the school, who gives instruction in the theories pertaining to his department, and also superintends the manual work. Prof. C. B. Rearick is instructor in drawing.

About five thousand dollars have been expended in equipping this department. It was first located in the basement of the west wing of the main University building, and was burned out. Most of the equipment, however, was saved, and the school is now conducted in a leased building. A separate and suitable brick building will be erected on the campus this summer, ample for ts accommodation and free development.

THE INFLUENCE OF THIS SCHOOL UPON THE STUDENT.

The course in this department is intended to cover four years, and embraces four rooms or stages of progress, viz.: plain wood-work or joinery, wood turning, work in cold iron and the forge-room. It is no part of the scheme to manufacture anything for commerce, but to give practical instruction to the students in drawing and in the use of tools of every kind, and in the construction of all the forms and patterns of wood and iron work. Thus are educated together in the most natural and easy way the brain, eye and hand, developing at once the sense and method of useful form, and evolving ideas, mental conceptions and intellectual processes into the material of practical life. The scholar is also a mechanic. While he thinks, action is present. While he studies, he learns to do. He comprehends the necessity of mental and physical cooperation as equal elements of success. He creates or preserves habits of industry. He prepares to help himself in after life as occasion requires. He is rendered independent. This condition makes him confident and self-reliant. Gradually it dawns upon him that study and toil are only

different applications of the same intelligent force, of like merit, and worthy equal honor. Thus the first principle of good citizenship impresses itself upon him. Every one must do something "to earn a night's repose." He perceives that an idle philosopher is not so valuable to society as a chimney-sweep, and that truth dormant and inactive, however great, is of less value than junk or old rags on the way to market.

The workers move the world to-day. All the mighty forces that once poured through the gates of civilization in ruinous war are now engaged in wonderful competitive activity in commerce, construction, art and manufacture. The man that can think and do in this age must surpass the man trained to think but not to do. The hand of industry is every hour growing into greater comparative importance. Hitherto it has been committed for instruction to the minor schools and to tradition. It was denied a position by the side of the professions. Now the spirit of the age calls the industrial pursuits into the halls of the university, and crowns the hand of toil and the implements of industry with the same honor in which it clothes the bar, the bench and the forum. Thus passes away the cruel and barbarous period of personal preference, based on no merit but the accident of birth or calling—a monstrous imagination that has harassed and oppressed nine-tenths of mankind for centuries.

Seventy-three students have this year entered the Manual Training School, and a want of room prevented a greater number. The bounty of the General Government enables us to deal liberally with this department. There are no special charges for anything. Paper, pens, ink, drawing instruments, desks, models, wood, lumber, tools, work benches, metals, supplies, forges, and all the necessary and costly machinery and outfits, are furnished every student without cost, just as scientific instruments, maps, charts, technical books and suitable equipment are furnished to other departments. A substantial building, designed with special adaptation to the uses of this department, will be a strong feature upon the campus. This will be erected from means supplied by the State. Thus the State and Nation join in welcome of the industries to the home of the classics and sciences.

The Agricultural Building fortunately escaped destruction and this college, with its comprehensive departments, is recognized as a very essential member of the University.

The Agricultural College.

From what precedes, it is evident that the Agricultural College in the University, embracing the School of Mines at Rolla, the Military, the Mechanic Arts and the other important schools mentioned, with yet capacity for still greater enlargement, and having at the same time control of the farm, the Horticultural department, and the Experiment station with its revenues, constitutes a strong element in university organization. The Curators have given it special consideration in the endeavor to foster its highest interests and bring to its support the popular favor its importance and merit demand. In a prominent position upon the campus it has a commodious building for its own special uses, heated by steam and hot air, repaired and improved throughout during the present year at a cost of over $6,000, newly equipped for its work and elegantly appointed in every part. It wholly escaped injury by the fire. To-day the Agricultural College building stands alone, but soon will be one of a group of modern buildings, erected like itself for the special use of the several departments, and standing coequal with engineering, physics, medicine or law, and having an income greater than any other department. Seventy-one students, professional agriculturists, have this year entered this department, and are pursuing a special and technical course of study to equip themselves for their life work, in like manner as medical or law students, either of which schools they excel in number.

The Agricultural College is succeeding far beyond expectation in its own special work and professional course; and when it is allowed that by legal association and community of organization and support from the same fund, there are due to it the courtesies of the School of Mines, the Military School and School of Mechanic Arts, its interests, power and influence as compared with the other departments are imposing and of wide range. In former years it has been impeded for lack of sufficient means to meet its necessities, the physical sciences being very expensive as compared with the classics and similar learning. But for the present the income of the Agricultural department is deemed ample for the pay of its professors and for all the "facilities for instruction," to which uses alone it is limited by law. It will therefore be inexpensive to the State, except for buildings and fixtures.

It is our opinion that time will prove the wisdom of associating together all these departments of learning and building up one great University, instead of dissipating the energies of the State at far greater cost and loss of that massive effect produced by a grand unity, which is in itself a mighty influence over the imagination in fixing the attention, inspiring ambition, creating energy, exciting enthusiasm and impressing every one with the earnestness, zeal and self-respect that spring from the combined power of all. Besides, all learning is of the same nature, all truth is of the same essence, and all students far into life pursue the very same studies and investigations. Only when the practical demands for business and subsistence begin to press do they differentiate into law, agriculture, mechanics, medicine and the various specialties. Moreover, the association of all the schools multiplies the influence and benefits of each, and through acquaintance and friendship draws together the young men of the State, producing a good understanding, obliterating local prejudices and follies of business distinction, and creating a spirit of toleration and mutual self-respect. Agriculture, far from suffering by this association in the University, must itself, by the inherent purity, beauty and beneficence of its learning, in which is nothing evil, tend to the advantage of all other departments, and they have a deep interest in its permanent presence upon the campus.

The burning of the main building is referred to as a matter of history; and details are given of the prompt action of the legislature and of the public spirit and generosity shown by the people of Columbia, in supplementing the State appropriation.

"The 36th General Assembly" made immediate provision for the needs of the University by creating a building fund of $237,000. The plans for the placing of the new buildings are already decided upon.

The buildings will be erected upon a quadrangle extending lengthwise from north to south, and being 300 feet wide—the west line facing with the east wall of the Agricultural College building, which will form one of the group, and which is really the initial point determining the position of the other buildings.

The new main building will stand to the south of the position of the old one and at the head of the quadrangle facing north. The main building cannot be erected at present. It is estimated that it will cost $300,000, and the 37th General Assembly will be asked to appropriate that amount for the purpose. No plans, however, have been drafted for this building.

The building of six other buildings are authorized; among them is one for the Manual Training School.

An insurance of nearly $150,000, on the main building and the library and apparatus, is fortunately available for the creation of new collections of books and instruments.

Girls are admitted to the Academic Department of the University. The following paragraphs from its catalogue, relate to their student

life; the provisions regarding dress are not devoid of interest. One wonders whether, sometimes, some fair student has not risked "ten demerits a day" for some favorite hat. Can it be, that the innocent coquetry of the sex, has been here wholly eliminated?

Young Women.

(Mrs. J. P. Royall in charge.)

It is now twenty years since the University was opened alike to both sexes. The number of young women matriculating has increased steadily from year to year, and now exceeds one hundred. In this University, as in so many others, co-education has thoroughly approved itself, and is now passed quite beyond the stage of experiment. Large liberty is allowed in the selection of studies, but the same demands are met by all members of the same class, and the young women often distinguish themselves in the severest subjects. The lady in charge, whose chief duty it is to chaperone her wards, extends to them at all times the friendliest counsel and sympathy, and every other provision is made for their health, comfort, convenience and improvement. While no such educational advantages for young women are to be found outside of a University, the expense is even less than at ordinary schools for girls.

DRESS.

A simple uniform, becoming to all young women, is particularly desirable for students, as it not only economizes time, money and attention, but also identifies them, outwardly, with the University, while at the same time it abolishes in a measure the distinction of rich and poor. Accordingly the following has been adopted as the attire of matriculates for every day, regular and special holidays excepted:

A walking suit of black cloth with black trimmings. During the first month of the first semester and the last month of the second semester, a white basque or waist may be worn instead of a black one. The hat must be black, but its shape and material are left at discretion, except that ornamental trimmings, such as flowers and feathers, are forbidden. The rule of the Faculty, authorized by the Board of Curators, prescribing this uniform, *is enforced by a penalty of ten demerits for each day's violation of it.*

LITERARY SOCIETIES.

Of these, there are two, the Philalethean and the Thalian. Both have large membership, and afford the young women ample opportunity for culture in forms of discipline, such as the composition and presentation of addresses, orations, essays not especially provided for in the ordinary curricula, and of these opportunities they have not been slow to avail themselves.

In the new University buildings there will be made the most complete and perfect provision of society and study halls and other apartments for the young women.

A Young Woman's Christian Association recently organized with a large active and associate membership is doing an earnest and zealous work, sure to be crowned with beneficent results. All the professional departments of the University are open to young women.

The latest official publication by the authorities of the University, is the Biennial Report made by the Curators to the General Assembly under date of January 1st, 1893.*

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* Biennial Report of the Board of Curators to 37th General Assembly for the two years ending December 31, 1892. Jefferson City, Mo. Tribune Printing company, State Printers and Binders. 1893. Pp. 107.

This is subsequent to that made by them to the Governor, which accompanies the catalogue already quoted.

The urgency of the need of generous state support to the University—caused by the disastrous conflagration of January 9th, 1892, in which the great main building was destroyed; together with the valuable libraries and scientific apparatus, so indispensible to the methods of modern education—affords to President Rothwell, of the Board of Curators, a fit opportunity, not only for urging upon the attention of the Legislators of the State, the present exceptional needs of the Institution; but, also, for emphasizing the value and importance to the State of a true University.

These statements of the vital connection which exists between the University and the public schools of the State; and the defining of the essential parts which go to the making of a true University; are of weighty import to all American communities, and are well and clearly put.

In speaking of the University in its economical relations to the State, he says:

THE UNIVERSITY IN STATE ECONOMY.

There are four essential elements of University success and usefulness, viz.: Faculty, buildings, equipment and students. Of these, the corps of instruction is first in order and force. High character, strong intellect, comprehensive, accurate learning, practical wisdom, correctness of purpose and sincere love of their work are the qualities demanded. The selection of the professors must depend upon the good judgment of the managing authority, with the means placed at their disposal. In selecting a faculty, it has been the aim of the Curators to make such a reputation for the University that a professorship in any of its departments shall be not only a guaranty of intellectual force and scholarship, but, what is of far greater moment, evidence of moral worth and irreproachable character. Should any fail in this regard, it would be a cause for displacement without hesitancy. Our present Faculty we believe worthy the utmost confidence. They are presided over by a president of the most eminent moral qualities and irrepressible intellectual force; a man of noble character, high sentiment, broad views of life and destiny, and under all conditions guided by the greatest of all purely mental endowments, good common sense. The Faculty are able, learned and laborious. Amid the wreck and waste of the fire, in rented rooms and with depleted accommodations, they, by their combined effort and great excellence of work, have kept the University intact and helds its student corps to a higher number than when the great main building stood with all its comforts, conveniences, equipment and libraries. Facts are better than words. No commendation could add to the testimony of these results. They fully justify the State for the outlay it has made or may make in supporting their endeavors by providing amply all needed facilities. To supply buildings and equipment is the office of the State, and this duty will be discharged according to its ability and its appreciation of higher education. Students in any number will not be wanting where the conditions are equal to the necessities of modern education. There is no investment which a State can make equal to a great University. There is no advantage to a people so noble in itself, so grandly enduring in results, so far-reaching and irresistible to influence. It is at once a monument to constitutional vigor and character, and a mighty controlling power. A University is the laboratory of the highest thought, the training school of genius. It gathers together and utilizes the mind-power of a people, conferring upon it the strength of trained

exercise, the momentum of a compact moving body, the readiness of practical and accurate drill, the armor of broad and liberal learning.

WHAT THE UNIVERSITY DOES FOR A STATE.

The most real wealth of a State is cultivated intellect, neither diminished by use, damaged by fire nor wasted by flood. The University supplies to the State an accumulation of mental equipment and reserved power ready for any emergency of statesmanship, war or scientific application; and this necessity for provident preparation is constantly growing. The State which neglects it must eventually yield to that which supplies it. True, here and there some great minds have and will continue to develop without special training; but these are exceptions, and even in these isolated cases it will be found that such minds are the production of the institutions under which they live. Taking no notice of the forces in society that have strongly impressed and characterized them, they are considered self-made; but they are the genuine offspring of their time. The prepotency of racial features and political, moral and intellectual conditions and natural environment are too often in these cases overlooked.

The influences of universities are not alone direct upon their students, but also strongly indirect upon the people. They exercise a potent secondary influence almost boundless in its beneficence. Through the popular love of the land they mingle the strength, precision and ambition of a higher education. They thus uphold the purpose of the people, and stimulate them to more thorough mental preparation in reading, study and attention to greater problems in government, business and scientific methods.

The sciences are now everywhere regarded as the friends of the most common and practical concerns of every-day life. They are no longer confined to the laboratory as curiosities of the few, but have gone out to the shop, the field and the factory. The university is the demonstrator and teacher of their uses; the people are the recipients of their benefits. The light which the university spreads is diffused for all. It reaches with gentle touch every shady place in life.

THE UNIVERSITY AND THE PUBLIC SCHOOLS.

The universities are the steadfast friends of the public schools. Thomas Jefferson created the University of Virginia; he also was the author of the school system of Virginia. The interest of the University and the public school is one. They are complements the one of the other. They cannot be divorced without immediate and permanent injury to both. In our constitution they together constitute the public school system. Both are made subject to the same State control and entitled to the same conscientious care and adequate support. The university and the public school in Missouri are of the same blood. They differ only in their offices. The university is not an interest separate from the popular interest. Its teachings are not contrary to the truths taught in the public school. All truth is of one essence and agrees with itself. The public schools deals with facts and elements, the university with the reason and principle of things, and scientific investigation and experiment, whereby the bounds of human knowledge are enlarged for all, finding its speedy way into the smallest concerns of practical life. This is now the best thought of the civilized world. In Germany her great universities at Berlin, Leipsic, Gottingen and Strasburg are not more distinguished for higher learning than are her minor schools for efficiency and usefulness among the people. And who for a moment would assert that Cambridge and Oxford had been detrimental to the commons of England, two forces that more than any others have supported the English dominion by endowing the English mind? For these two universities it is claimed that "they carried the English flag around the world."

With equal pride all Americans regard Yale, Harvard, Dartmouth, Bowdoin or Princeton, and shall not Missourians love and cherish their University, now rapidly

growing in power and usefulness? Certainly Missourians cannot be so short-sighted as not to do all they can for so grand an interest.

Their public school system is unsurpassed on the continent. They will make their University correspondingly great and successful. In every age great scholars, profound thinkers, overmastering intellects, wonderfully accurate scientists and ingenious inventors are a necessity, but especially so in this age of surprise, newness and mighty progress. The energies with which the world once wasted itself in war are now turned to intellectual dominion and the triumphs of learning. It is not the mighty tread of nations sounding along the highway that leads to conquest now, but the silent hosts of thought and the viewless march of mind. The camp of civilization is pitched in the lecture room and in the laboratory. The standard of the university is set up where once the eagles of the Legion stood.

In this connection the following words in a leading English Paper, (The Manchester Guardian of May 29th 1893), commenting upon Monsieur Lippmann's remarkable success in Photographing colors, furnish strikingly corroborative testimony to President Rothwell's estimate of the value of University Training in our modern civilization.

Speaking of this final conquest of nature so long and earnestly sought ever since Daguerre first taught man to force the sun to make his pictures, the Guardian says, speaking to an English audience: "The discovery itself was no matter of chance; its author, who has long been known for his remarkable researches in pure science, foresaw it as a necessary consequence of scientific theory. We cannot refrain from pointing a moral realized abroad but not yet here. The majority of really fruitful discoveries in chemistry and physics come not from the so called practical man nor the half educated pupil of a lad's technical school, but from the brains of those who, like a Kelvin, a Lippmann, or a Perkin, have mastered the most abstruse principles of their science. It is on our Universities, and a half dozen first-class technical schools, that we must spend our money if we would see it bring in any serious return. It needs little imagination to perceive the value of a discovery like M. Lippmanns, which widens so immensely our artistic and our scientific horizon. All Englishmen will join in congratulating the Physicist capable of such an achievement."

A New Main Building a Necessity.

The President, makes the following plea for the rebuilding of the Main Building:

Missouri has done much for her University, both in endowment and buildings. She has laid the groundwork for a great institution. But it is an enterprise that never ceases. It would be a pity if it did cease to press, by its active demands upon the State. Neither have we yet recovered from the losses by the fire. The most primary need of the University just now is a main building. It should be provided for at once. The University work can scarcely progress without it. Indeed without it a large part of the work must break down or go in a very crippled condition. The Curators have considered the subject, and, though not adopting certainly, yet have very much approved a certain plan. This is estimated to cost for building and equipment $300,000. If this building should be provided for, the united capacity of all the buildings would, it is thought, be sufficient to care for easily 1,200

students. It is a crisis with the University. It is undoubtedly in a very prosperous condition. But hope is a strong element in its present success. The students believe their present awkward situation will be relieved by the erection of the main building. They have faith in the State's good purpose to provide liberally for them in this respect. Should they be disappointed there is no foreseeing the result. It could but be unfortunate. If this main building is supplied at this time, the success and steady progress of the University is secured for the future. There can be no doubt on this point. The institution would be one in which every Missourian might well feel a just pride. Its influence in enlarging, broadening, strengthening and equipping the mind of the youth of the State for the great and serious work of life would be incalculable. The matter is committed to the General Assembly in the earnest hope that they may have the means for this grand purpose.

The sum of 236,577 was appropriated by the Legislature March 24, 1892, for rebuilding at Columbia; provided the citizens would pay $50,000 to the Curators for the same purpose; and would further comply with specified demands as to water supply and protection against fire. These demands having been met, the following plan was adopted.

KIND OF BUILDINGS.

Two courses of action seemed from the beginning open to the Curators, viz.: to erect a main building, or to erect a number of department buildings. On consideration it was ascertained that the amount appropriated was insufficient for the erection and equipment of a main building with any fire-proof qualities, and further, that greater accommodations could be secured, and more pressing wants met for the present, by several structures than by one; therefore, after mature consideration, it was determined to erect a system of department buildings.

In devising the system, the whole subject and all the conditions were thoroughly canvassed, and future buildings and improvements considered, so that convenience and economy might be secured and harmony of design attained now and hereafter. The number and capacity of the present buildings of course would be limited by the provisions of the act, which required that no building or buildings should be begun which could not be finished within the appropriation. It was found possible under this limitation to erect six buildings, viz.: a boiler and engine house for heating and power, a Manual Training building, a Physics and Engineering building, a building for Biology and Geology combined with a Museum, a Chemical Laboratory and a Law building. A comprehensive campus plan was surveyed and adopted upon the idea of a quadrangle or elongated court, 300 feet wide from east to west and extending from north to south. The new buildings are arranged on each side of the quadrangle, the Agricultural college building being one of the group. Future like buildings can be in harmony with them. It is the design to place the main building at the south end of the quadrangle when it shall be erected. The magnificent and imposing columns of the old building stand in the center of the court, and will be left standing—a sacred ruin and a sad memorial to the lives of the old students, a monument of progress to the new. When the legislature shall provide the means, the court will be cleared and graded and put in tasteful harmony with all the surroundings, new and old.

The Manual Training Building to be completed in February, 1893, is thus described:

MANUAL TRAINING BUILDING.

The Manual Training building has a frontage of 108 feet by a depth of 117 feet. It consists of two stories and a full basement. It has six shop rooms 40 x 40 feet; an exhibit hall 25 x 40 feet; two offices 16 x 18 feet; one drawing room 40 x 40

feet; two class-rooms 18 x 22 feet, besides store-room, engine-room, lavatories, etc. The driving power of the machinery is a 90-horse power Corliss engine. * * * When in full operation it will accommodate 400 students by classes, 24 in a class, and two hours to a class each day.

Besides his plea for a new main building, the President sets forth the absolute demand for Library and Apparatus:

THE LIBRARY.

The University ought in the next ten years to contain 50,000 volumes. Books are the student's implements. He toils with books. He lives, grows, expands by books. His companions are books. He is never educated till he learns to love books. He is never prepared for the intellectual contests of life until he is thoroughly equipped with the knowledge of books. The student must have books. If his own State does not furnish them, he will go elsewhere where they do abound. There cannot be a great University—indeed there cannot be any University at all—without a great library. We ask but a small appropriation for this purpose, but the Legislature ought to go beyond it, and not postpone for years a good which the present so imperatively demands.

SCIENTIFIC INSTRUMENTS.

* * * * * * *

The modern sciences cannot be efficiently taught without proper equipment. The sciences are not only intellectual and theoretic; they are likewise material and practical. They deal with facts as well as ideas. Their conceptions are evolved in the exercise of delicate and dangerous powers, intimately connected with the business, commerce, travel, construction, manufacture, production, health, happiness and progress of the world. The student of the sciences goes directly from the class-room and laboratory to the application of his thoughts to the material wants and vast complicated industries of mankind. He is trusted on his diploma, without question, as qualified practically for his profession. It is little less than a crime for the State to give him this reputation by its endorsement, without the full means for preparation to sustain it. This cannot be done without suitable equipment. One cannot learn to chop or hoe or plow by merely talking, theorizing or reading about it. He must see and handle the instruments. What theory could make one practical master of an engine? What discussion or lectures could place one in safe control of the intricate, subtle and quick-acting, faculties of electricity in its vast and increasing application to human affairs? The answer comes at once. We listen to the theorist; we trust the practical man. The student must be made thoroughly practical. His education must be as intensely factual as it is thoroughly scientific. The immaterial thought must be grasped, but the embodied principle must also be seen, felt and controlled.

The movement for thorough and complete equipment is now most decided in all the great colleges and universities in this country and Europe. It is felt to be an absolute necessity. Missouri, in the erection of her grand new buildings, is laying the foundation of the most magnificent University in the West. A few years hence and it will be the admiration of scholars, as it is now their hope; students will flock to its halls from many States and post-graduates gather at it to prosecute their studies and perfect their work.

To return to the catalogue of 1891–1892. The "Academic" Departments of the University, number fourteen; seven under the head of "Language," and seven under that of "Science." There are eight "Professional" Departments; these are the same as those given in the catalogue of 1881–1882, only that from the list there given,

the ninth, "Commercial," has been dropped. Of these The College of Agriculture and the Mechanic Arts, is known as No. XV of the University Departments, and as No. 1 of the "Professional" Departments.

"This College had its origin in the beneficence of National, State, and local governments. Its location, objects and aims, are defined," in "acts of Congress and in the laws of Missouri."

LOCATION.

The College of Agriculture and Mechanic Arts is located at Columbia, Boone county, in the north central portion of Missouri, one of the most beautiful towns of the State, containing about four thousand inhabitants, noted for their culture, refinement and morality, and surrounded by a region of country of well-known healthfulness and fertility.

ENDOWMENT OF THE COLLEGE.

The support of the College is derived from:

(1) The preceeds of the sales of the public lands donated to Missouri by the act of Congress of July 2, 1862. This State received as her share two hundred and seventy-five thousand acres, of which there have been sold up to date two hundred and sixteen thousand seven hundred and sixty acres, yielding three hundred and twelve thousand dollars, which sum is invested in a State certificate of indebtedness, at five per cent, yielding fifteen thousand six hundred dollars; of this amount one fourth, or three thousand nine hundred dollars, is by law appropriated to the support of the School of Mines and Metallurgy, at Rolla.

(2) The annual appropriations from the United States treasury by the act of Congress of August 30, 1890, of fifteen thousand dollars for the years 1889-90, and increased each year by one thousand dollars, until it reaches twenty-five thousand dollars, which shall remain au annual appropriation. Of this amount, one-sixteenth is by law appropriated to the "Lincoln Institute," at Jefferson City, for the education of negro children in agriculture and mechanic arts, and one-fifth of the balance to the School of Mines and Metallurgy, at Rolla.

(3) The act of Congress of March 2, 1887, known as the "Hatch bill," appropriates fifteen thousand dollars annually to the College of Agriculture, for the purpose of conducting investigations and experiments in various lines of work connected with agriculture. By the acts of Congress making the above appropriations, the expenditures are expressly restricted to the purposes of instruction, illustration and original scientific investigations in agriculture, and not one dollar can be used for the erection or repair of buildings; such facilities are to be provided by the State of Missouri.

(4) The College building and Experimental farm, donated by the citizens of Boone county, and costing originally ninety thousand dollars.

The above sums, together with the assistance derived from the association of the College of Agriculture with the University, furnish an abundant income for all purposes of instruction and experimentation.

The subjects in the "outline of studies" are given under twenty different heads. The following is the outline of the course in:

DRAWING AND SHOP-WORK.

The aim of the instruction in this department is not to make finished mechanics or artisans; it is not designed to be a "Trade school," but is designed, primarily, for intellectual development and discipline; and, secondarily, to cultivate habits of physical training, and to make farmers' boys familiar with the tools and processes,

in working wood and iron, and to give them such training as will enable them to perform with facility the ordinary mechanical operations of the farm. The course of instruction embraces:

COURSE IN DRAWING.

First Year.—Free-hand and Instrumental drawing, which is taught by lectures, and from objects, models, and flat copies, including intersections, development of surfaces, and lettering.

Second Year.—Mechanical drawing, isometric projections, plans, sections, and elevations of machines, and structures.

Third Year.—Geometrical drawing, tinting, brush and line shading; shades and shadows.

Fourth Year.—Original professional work.

COURSE IN SHOP-WORK.

First Year—Wood-working and Pattern-making.—This course begins with a series of exercises in wood-working, each of which is intended to give the student familiarity with a certain application of a certain tool; and the course of exercises, as a whole, is expected to enable the industrious student easily and exactly to perform any ordinary operation familiar to the carpenter, to the joiner and the pattern-maker. Time permitting, these prescribed exercises are followed by practice in making members of structures, joints, small complete structures, patterns, their core-boxes, and other constructions in wood. Particular attention will be paid to the details of pattern-making.

Second Year—Forging, Molding and Foundry-work.—These courses are expected not only to give the student a knowledge of the methods of the blacksmith and the molder, but to give him that manual skill in the handling of tools which will permit him to enter the machine-shop and there quickly to acquire familiarity and skill in the manipulation of the metals, and in the management of both hand and machine tools.

Third Year—Machine-work.—The instruction in the machine shop, as in the foundry and at the forge, is intended to be carried on in substantially the same manner as in the wood-working course, beginning by a series of graded exercises, which will give the student familiarity with the tools of the craft, and with the operations for the performance of which they are particularly designed, and concluding by practice in the construction of parts of machinery, and, time permitting, in the building of complete machines, which may have a market value.

Fourth Year.—Original work in construction of machines or parts of machines, or special devices.

This college offers four classes of "courses" in Agriculture, namely: I. A three months winter course of "Lectures and practical illustrations," for young men unable to give the time for a regular college course; II. A two years course, comprising the first half of the regular four years college course; III. A four years course; IV. A two years Post-Graduate Course, "designed to give a professional training in one or more of the schools of this college."

"As the college was re-organized in September 1st, 1891, only the First year class has been admitted."

The total number of students in 1891–'2, was 205. Of these 89 took Drawing and 71 Shop Work.

The Faculty of the college numbers 18 Professors and Instructors, including the President of the University, who is ex-officio Chairman

of the Faculty. Edward D. Porter, A. M., PH. D., is Dean of the College and Professor of Theoretical and Practical Agriculture.

The Department of Engineering at Columbia.

GENERAL STATEMENT.

The School of Engineering is designed to furnish the students the means of acquiring a thorough knowledge, theoretical and practical, of those sciences and arts which are playing the most important parts in the development of the material resources of our country, and the advancement of our civilization.

The advances in scientific and technical education made in the last twenty years have been largely in the direction of the introduction of a certain amount of laboratory and practical training into courses of study which formerly consisted exclusively of text-books and theoretical work. The results of this innovation have been so satisfactory that it is no longer a question of debate. To this end it will be observed that shop-work, field-work, laboratory practice and drawing are made prominent features of the Engineering courses.

The sphere of the engineer is so broad and diversified that it is impossible for anyone to become proficient in all the various specialties into which the profession has been so divided. To meet the demands for special engineering studies and training from the end of the second year of the studies laid down in the Engineering Synchronistic table, three parallel courses have been arranged, (see page 99), so as to allow of option and diversity of special studies. This department will thus foster the development of special fitness in each student, by offering him work in the line of his preferences. These courses are:

I—Civil Engineering.
II—Hydraulic and Topographical Engineering.
III—Electrical Engineering.

The course in Civil Engineering is designed for those who wish to make either road engineering, or railroad engineering, or the designing and construction of bridges and masonry, a specialty.

The course in Hydraulic and Topographical Engineering is arranged for those students who wish to make either geodesy, or irrigation, or water-works, or dams and foundations, or river improvement, a specialty.

The Electrical Engineering course has been established to meet the wants of young men desirous of entering upon the rapidly developing field of the applications of electricity to the arts. Its leading studies are physics, especially theoretical and applied electricity, mechanics, mathematics and chemistry. The course is made strong in shop-work, mechanical engineering and mathematics, because in many branches of electrical engineering a sound and practical knowledge of mechanics, measurements of power and its transmission is essential.

The total number of students for the year ending June, 1892, were 52. Total number in the Drawing classes of the Engineering School, 28. The Faculty numbers 12 Professors and assistant Professors, including the President of the University. Thomas Jefferson Lowry, S. M., C. E., is Dean of the Faculty, and Professor of Civil and Topographical Engineering.

School of Mines and Metallurgy, Rolla, Mo.

"The School of Mines and Metallurgy," a department of the State University of Missouri, is situated at Rolla, Phelps County, on the Atlantic and Pacific Railroad, 113 miles south west from St. Louis, in a district abounding in deposits of iron, lead and zinc. This school

was created by act of the Legislature of February, 1870, disposing of the United States grant.

The School was opened November, 23d, 1871, graduating its first class June 1874.

"The design of the School of Mines and Metallurgy, in connection with the Agricultural College, is to carry out, to its amplest extent, the intention of the act of Congress, providing for education in the Industrial arts. This has been kept prominently in view in arranging the curriculum of the school, in the selection of its apparatus, in providing its equipments, and in the organization of its Faculty. It is a school of Technology, with Civil and Mine Engineering and Metallurgy, as specialties.

The school is well furnished with apparatus, instruments, and other appliances for practical instruction and demonstration. It has a full supply of excellent surveying and engineering instruments, physical apparatus, embodying the newest forms for illustration and research, together with diagrams and models for the illustration of metallurgy, and for engineering, topographical and ornamental drawing."

The School has a preparatory department with a course of one year. There is, also, a "Girls' Course in Arts," extending through four years. In this course Drawing is one of the required studies through all of each year.

The course for the degrees of "Mining and of Civil Engineer" is of three years. Drawing is a required study through the first two years of the Mining course; it extends through the entire course in Civil Engineering. The following schedule of the course in Graphics is from the Report of 1881–'82.

GRAPHICS.

(Professor Emerson).

"During the preparatory year, the students are instructed in the elements of drawing, with pen and pencil, according to the principles contained in Chapman's Drawing-book. They are also practiced in freehand drawing. These exercises develop the special tendencies of the student, and enable the Professor to judge in what direction his greatest strength lies, and where his week points most need to be reinforced.

During the first year, the practice is in topographical drawing, with pen and India ink, representing the lines of contour of the earth's surface, showing the bounding curves which would limit the surface in case of a gradual rise of water; taken at every 5, 10 or x feet. The hatching lines of declivity are drawn; also, the various conventional representations of surface. The students are exercised in a carefully organized method of drill in printing, in order to acquire a rapid system of lettering—of essential importance in finishing maps, problems, title pages and mechanical drawings. There is also a careful study of the true standards of the three colors, with their secondary and ternary combinations, simultaneous contrasts, harmonies, unisons, aerial perspective, and the important practical application of laying on flat tints. This is followed by applications to colored topography, etc.

The second year's exercises are in construction of problems in descriptive geometry, and in shades, shadows and perspective. The problems are drawn with pen and India ink on demy drawing paper, and all are constructed on mathematical principles, displaying all the difficult problems of the intersection of curved surfaces, and the representations of warped surfaces having two or three directrices.

In the third year, the subject of stereotomy is taken up, in its applications to the

various problems of stone-cutting and the construction of terre-pleins, ramparts, ramps and embrasures of permanent fortifications. There are also required drawings of bridges, furnaces, machines, their shadows and perspective, as they would appear to the eye, at a finite distance from the perspective plane, mathematically constructed and properly colored.

Those who possess the requisite taste for such subjects, may be exercised in pen, India ink and color drawings of landscapes, figures, etc., and be led to apply their acquirements to natural history."

The catalogue of 1891-'92, contains two photograph reproductions; one a view of the school building, and one, of the student's Dormitory or "Club House," both substantial buildings; the last affords comfortable accommodations for thirty students.

BUILDINGS AND EQUIPMENTS.

The buildings of the School of Mines are situated in the most elevated part of the city of Rolla. They are substantial brick structures, well ventilated and lighted, and heated by the best furnaces manufactured. The main building has recently been painted and kalsomined throughout, and the laboratory, one of the most complete in the country, has been in use but five years.

The different departments of the school are well supplied with apparatus.

The range of the student's necessary expenses for a year, including college dues, and board, are estimated from $125.00 to $174.00. An "Academic Course" of three year was established by law in 1885.

The School of Mines and Metallurgy is an Institute of Technology with a regular course of three years; which are known respectively, as "Junior" year, "Intermediate" year, and "Senior" year. All the Engineering courses are the same through Junior year.

The course of instruction deals in detail with the principles and the practice of Engineering, with special reference to Mining Engineering, Civil Engineering, Mechanical Engineering, Chemistry and Metallurgy, Mathematics, Physics and Electricity, and includes recitations, lectures, laboratory work and field practice. While a theoretical knowledge of each subject is required, great importance is attached to laboratory work and field practice as a source of mental training as well as a preparation for active pursuits. In the first of these, while a certain standard of excellence must be attained by all, the class system is not adopted, but each student, working independently of others, advances as rapidly as possible.

* * * * * * *

Provisions are now made for the following technical courses:

I. Mining Engineering.
II. Civil Engineering.
III. Mechanical Engineering.
IV. Chemistry and Metallurgy.
V. Mathematics and Physics.

Each leading to the degree of Bachelor of Science.

* * * * * * *

Besides these regular courses, there are the following special ones:

I. Assaying.
II. Surveying.
III. Electricity.

On the satisfactory completion of any one of these a certificate of proficiency will be given. The requisite for admission to one of these courses is an adequate knowledge of the preparatory subjects.

The following is the general statement of the training in drawing required in the Engineering Department of the School.

DRAWING.

First year.—The first year's work for all regular students in the Engineering department is almost entirely at the drawing-board. Here belongs naturally all work in Descriptive Geometry and in Stereotomy. The use of drawing instruments—simple problems in points, lines and planes—graphical solution of the more complicated problems—shading of projections, in pencil, by free-hand pen-work, with the ruling-pen, in water-colors and India-ink.

Second year.—Work assigned according to the profession chosen by the student. The students in Civil and in Mining Engineering will select some complete engineering structure and present it in simple plan and elevation—one in axonometric, another in perspective—all neatly shaded, tinted and lettered. All field surveys must be plotted neatly, and one topographical drawing made from notes taken in the field by the student will be required of each. The student in Mechanical Engineering will be continuously exercised in mechanical and machine drawing.

Third year.—Seniors have a variety of exercises in Graphical Statics, and are required to present working drawings of many structures, such as bridges, arches, dams, etc. The thesis must be accompanied by drawings fully illustrating it.

The total number of students in the School of Mines, is given as 83.

The Faculty number nine Professors and Instructors, including the President of the University. Elmo G. Harris, C. E. (University of Virginia), is the Director of the School and Professor of Engineering.

The following is the statement of the entire attendance of students in all the Departments of the University:

SUMMARY.

Academic Students.

Post-graduates	2
Seniors	18
Juniors	26
Sophomores	36
Freshmen	98
Preparatory	164
Special	16
Total	360

Professional Students.

Agr'l and Mech'l	*a*, Regular	71
	b, Special	134
Normal	*a*, Regular	108
	b, Teachers' course	16
Law		66
Medical		32
Engineering		49
Military Science and Tactics		193
Mining and Metallurgy		83
Total		749
Grand total		1,109
Names counted more than once		395
No. of individual students		714

The following is the condensed statement of the statistics of the University with which the Curator's report to the Governor for the year 1891–'92, commences:

Total number of students enrolled during the year at Columbia	631
Total number of professors employed during the year at Columbia	25
Total number of assistants employed during the year at Columbia	23
Receipts for the year ending December 31, 1891	$130,388.60
Disbursements for the year ending December 31, 1891	$120,139.25
Total number of students enrolled during the year at Rolla	83
Total number of professors employed during the year at Rolla	4
Total number of assistants employed during the year at Rolla	4

Richard H. Jesse, LL. D., is President of the University.

The University of Nebraska, Lincoln, Nebraska.

The United States Law of 1864, set aside seventy sections of land to found a University in Nebraska. February 15, 1869, the Legislature of the State, accepted the United States land grant under the law of 1862, for the establishment of colleges of Agriculture and the Mechanic Arts. These two grants of 44,800 and of 90,000 acres, respectively, were the endowment of the University, which the Legislature,—by act approved February 15, 1869, and amended February 19th, 1877,—authorized the Regents to establish. Lincoln, the capital of the State, was chosen as the most desirable place for the new Univerity.

The University was to include five departments or colleges, as follows:

1. A College of Literature, Science, and the Arts.
2. An Industrial College embracing Agriculture, Practical Science, Civil Engineering and the Mechanic Arts.
3. A College of Law.
4. A College of Medicine.
5. A College of the Fine Arts.

Of these only the first two have as yet been organized.

A careful examination of the "Tenth Annual Catalogue for the academic year 1881–'82," shows a small development, as yet, of the Industrial Department, with a total attendance of 26 students; of these 14 are in the "Preparatory course," 3 in the Freshman class, 4 each in the Sophomore and Junior classes, and one in the Senior. Of these one Junior, two Sophomores, one Freshman, and one in the Preparatory, take the Engineering course; all the others are "Agricultural" students.

The University aims to secure to all who may avail themslves of its advantages an opportunity for liberal culture in literature and science, and in such technical and professional courses as may from time to time be established; these advantages are offered to all *free of charge for tuition*, without regard to sex or race, or place of residence, on the condition of their possessing the intellectual and moral qualifications requisite for admission to such an institution.

There being in each department a preparatory course of two years

the full course in each is six years. In the Engineering course of The Industrial College, Drawing is required during the third term of Freshman year, and "Stereotomy" appears as a study of the third term of Senior year. There is a general announcement under the head of "Painting," that "Facilities are afforded for the study of Drawing and Oil painting under competent teachers." This announcement evidently refers to picture making and not industrial drawing, and drawing nowhere appears as a required study in any department of the University, with the exceptions already noted.

The Industrial College possesses, for its students in Agriculture, an improved farm of 320 acres, with orchards, vineyards, etc., and is well stocked. Bee keeping is made somewhat of a specialty.

The catalogue shows a total of 284 students, 26 as already stated in the Industrial Department, and 258 in the Literary and Scientific Department; of these last, 119 are in the preparatory classes, 51 divided between the four regular College classes—21 of these take the Scientific course;—there are besides 34 "Special," and 4 "University" students.

The catalogue for 1890–'91,* shows that no addition has been made to the colleges authorized, since the issue of that of 1881–'82. "The College of Literature and Art," and The Industrial College, still comprise all of the University. There is, also, a preparatory school known as the Latin School, with a course of two years; and a school of the Fine Arts, with two divisions; one of Music, and one of Drawing, etc.—There is, also, opportunity for Post-Graduate Instruction; and nineteen Professors, about equally divided between Literature and Science, offer instruction in their several branches.

"The principal buildings and appliances of the University are situated near the business centre of Lincoln. The Farm of the Agriculture Experiment Station, is on the eastern border of the City, within easy reach by horse car, or other conveyance."

There is a two years "Elementary Agricultural course," for those unable to give time for the full course. "Great prominence is given" in the Industrial College, "to the natural and physical sciences in the Scientific course, and to their applications in the special elective courses, and the course in civil engineering. Two lines of Agricultural instruction (Chemical and biological), and one in Applied Electricity, are offered."

The Faculty of the Industrial College comprises 28 Professors and Instructors. J. Sterling Kingsley, D. SC., Professor of Agriculture and Biology, is the Dean. Total number of students attending: Graduates 28, Academic College 174. Industrial College 90. Latin School 180. Students of Fine Arts; Music students 92, Art students

* The University of Nebraska, catalogue 1890–'91. Lincoln, Nebr. Published by the University. 1891. Pp. 104.

95.—Aggregate enrollment 660, names repeated 90. Total 570. The Faculty of the University, numbers 38 Professors and Assistant Professors. Charles E. Bessey, PH. D., Acting Chancellor.

College Of Agriculture, University Of Nevada, Elko, Nevada.

The latest information in 1882, regarding this institution, shows only a preparatory school with an attendance of 27 pupils; as yet, no instruction in Drawing, or Mechanic Arts, is provided.—

The University, chartered in 1862, was first opened in 1874. The latest catalogue* at hand, gives, in an appendix, copies of the laws of the United States, and of the State, relating to the institution; beginning with the U. S. Land Grant Law of 1862. To provide a "State University" with "departments for Agriculture, Mechanic Arts and Mining, to be controlled by a Board of Regents whose duties shall be prescribed by law," is made by the constitution of Nevada, the duty of the Legislature. The duties of the Board of Regents were stated in the act of March 5th, 1869. The Legislature, in the act of Feb. 7th, 1887, passed an act relating to the State University and matters properly connected therewith;" by which certain previous acts, or parts of acts, in conflict therewith were repealed. This act directs that a Normal School for the training of public school teachers, and a Commercial School, shall be connected with the University.

"There shall be no discrimination in the admission of pupils on account of sex, race, or color." This provision was a part of the first act.

In the Normal School, Drawing is a required study through the whole of the second year of the three years course.

In the College of Liberal Arts, Drawing appears in the list of required studies only during the first term of Freshman year.

In the School of Mines, Drawing is taught through Freshman year, and during the first two terms of Senior year. In the School of Agriculture, Drawing is taught the first two terms of Freshman year and the second term of Senior year.

Total attendance of students for the year 1891–'92, 163. There are 14 Professors and Instructors, in the Faculty, three are ladies. Stephen A. Jones, M. A. PH. D., President, and Professor of Latin Language and Literature.

New Hampshire College Of Agriculture And The Mechanic Arts.

The New Hampshire College of Agriculture and the Mechanic Arts, was chartered by the Legislature in 1866, on the basis of the

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*Register of the University of Nevada, located at Reno. 1891–'92. Carson City, Nev. J. E. Eckley. Supt. State Printing. Pp. 64.

United States Land Grant of 1862. It was placed at Hanover and in connection with Dartmouth College. By gift of the late Hon. John Conant, it possesses a valuable farm of 360 acres. The course of study comprises three years. A post graduate course of one year can be taken if desired. The course has special reference to agriculture. "Chapman's Free Drawing," is one of the required studies the first term of the first year. Drawing does not subsequently appear in the list of required studies.—

The student desiring training in drawing would naturally connect himself with the Chandler Scientific Department of the College, which gives a very thorough five years course in Mechanics and Civil Engineering.

The catalogue of 1881–'82, shows a total of 41 students in the College of Agriculture and the Mechanic Arts.—

The following authorized statement in a circular of the College of Agriculture issued in 1890,* shows concisely the general development of the college, as well as that in the lines of "Drawing" and "Shop Work," that has gone on since the foregoing showing was taken from the catalogue of Dartmouth College for 1881–'82.

NEW HAMPSHIRE COLLEGE OF AGRICULTURE AND THE MECHANIC ARTS.—IN CONNECTION WITH DARTMOUTH COLLEGE.

This institution is the State College of New Hampshire and by its location is one of the Scientific schools in connection with Dartmouth College.

Its specialties are Agricultural Science, Chemistry, Work-shop Instruction, and Mechanical Engineering.

There are two distinct courses, one in Agriculture and Chemistry, and one in Mechanical Engineering. In each course there are a number of elective studies, among which may be mentioned English Literature, Political Science, French, and German.

Of all the scientific courses offered in Dartmouth College or in connection with it, the course in Mechanical Engineering offers the most mathematical and technical work. While it is expressly intended for the training of mechanical engineers, it is also unsurpassed as a preparation for the post graduate course of the Thayer School of Civil Engineering.

The attention given to Chemistry is one of the marked characteristics of the institution. The work, required and elective, extends through three years.

The State College is the first Technical School established in the State and its two courses when combined with the various elective studies will be found well adapted to the needs of those who purpose to assist in the development of the material resources of the state and nation.

Its course of study has been lengthened and now covers four full years while the requisites for admission have been advanced. Thus time has been obtained for a high grade of technical work.

The Dartmouth Catalogue of 1890–'91,† includes among its Depart-

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*New Hampshire College of Agriculture and the Mechanic Arts, in connection with Dartmouth College. Lebanon, N. H. Press of A. B. Freeman. 1890. Pp. 16.

†Catalogue of Dartmouth College and the associated institutions for the year 1890–'91. Hanover, N. H. Printed for the College. 1890. Pp. 84.

ments, The Agricultural College, and The Experiment Station. In the opening words of the catalogue of the Agricultural College, after a concise summary of the National and State laws applying to this institution, the following statement is given.

The College is carrying out the provisions of these acts in the following ways:

First.—It gives a practical and scientific education, which is of use in all the professions and industrial pursuits.

Second.—It gives four special courses of study.

I. Course in Agriculture.
II. Course in Chemistry.
III. Course in Mechanical Engineering.
IV. Course in Electrical Engineering.

Course IV has just been established, and will be open to students at the beginning of the next college year.

Whereas formerly Drawing was only required during the first term of Freshman year, now both Drawing and Shop-work are required through the first two terms of Freshman year. In Sophomore year, Drawing is taken in the first term, and Shop-Work in wood and iron through all the year; neither Drawing, or Shop-work, are required during the first two years of the Agricultural course. In the Mechanical course, Drawing is required in each year, and "Shop-work" in every term of the four years course. The Agricultural Experiment Station is on the Conant Farm. The building for Mechanical Training is thus described:

WORK-SHOP.

The work-shop occupies a building fifty by thirty feet, containing forge-room, wood-working and tool-rooms, and a room for machine-work. It is provided with power, tools, and machinery. The plan pursued is to engage in work on articles which give the necessary practice, and will be, when completed, of practical value. During the past year a wood lathe has been designed and constructed, all pattern-making and other work, except casting, being done in the shop. Plans are being made for the erection of an additional building, and for providing a largely increased amount of machinery.

The total attendance of the students in all Departments of Dartmouth College for the year 1891–'92 is thus given:

Summary of students.

Dartsmouth College	258
Chandler School of Science and the Arts	63
N. H. College of Agriculture and the Mechanic Arts	36
Medical College	98
Thayer School of Civil Engineering	9
Total	462

The Faculty number 50 Professors and Instructors. Rev. Samuel C. Bartlett, D.D., LL.D., President. The Faculty of "the College of Agriculture and the Mechanic Arts" number 12 Professors and Instructors, including the President of Dartmouth. Charles H. Pet-

tee, A.M., C.E., Dean, and Professor of Mathematics and Civil Engineering.

The connection of this State College with the famous College at Hanover, was practically ended with the year 1890–'91.

In its beginning it was undoubtedly greatly advantaged by that connection, by which the students were able to avail themselves of the Libraries, and Laboratories, of the historic college; whose Professors, also, at first, aided in their instruction. The Agricultural College has, in addition to the grants made to it by the Nation and the State, been greatly favored by the gifts of individual citizens; and it is in compliance with the provisions of the will of the late Benjamin Thompson, of Durham, who has bequeathed to "the State College of Agriculture and the Mechanic Arts," a large farm and other real estate, as well as a large amount of personal property, on condition that the College shall be established in Durham, that the relations between Dartmouth College and the State College are now terminated.

The story of the college from its inception, with brief notices of the benefactors and the instructors, to whose gifts and efforts its success is due, is admirably told by President Stevens, in behalf of the Trustees, in the Twentieth Report of the Board of Trustees, made to the New Hampshire Legislature, in January, 1893. This is a handsomely printed pamphlet* of 287 pages illustrated with a frontispiece of the stately new college building at Durham, and with portraits of Rev. Asa D. Smith, D.D., LL.D., President of Dartmouth and first President of this college; of John Conant, the greatest benefactor to the college during its sojourn in Hanover; of Hon. G. W. Nesmith, long President of the Board of Trustees; and of Benjamin Thompson its latest benefactor.

There are, also, floor plans of the new buildings.—106 pages of this pamphlet are given to the history of the college, to the various official reports, and to a catalogue of officers and students, with programmes of courses, etc. An Appendix of 27 pages, contains a reprint of the laws both of the Nation, and of the State, which relate to the College. Part II, contains "the third and fourth annual reports" of the Experiment Station, established by the U. S. Congress, and attached to this College.

The following extracts from the historical sketch by President Stevens, will be found of interest as showing the steps in the evolution of a Land Grant College, and how it gradually grows into a technical school of science. In this case, also, it is interesting to observe how Governmental aid has stimulated individual generosity. This has been likewise shown in other instances, notably in connec-

* Twentieth Report of the Board of Trustees of the College of Agriculture and the Mechanic Arts to the New Hampshire Legislature, January Session, 1893. Concord: Ira C. Evans, Public Printer. 1892. Pp. 287.

tion with Cornell University. As an example of how local environment affects developement, it may be remarked that, while in many of these Land Grant Colleges the military features are made prominent, there is no evidence, in the programmes of "courses" in this college, that any one connected with this New Hampshire College ever read that portion of the U. S. Law of 1862, which refers to the teaching of military tactics.

REPORT.—HISTORICAL SUMMARY.

To the Honorable Senate and House of Representatives:

The trustees of the New Hampshire College of Agriculture and the Mechanic Arts respectfully submit their twentieth report, and, in compliance with a request from the United States treasury department, preface it with a resumé of the history of the college from its organization, to the passage of the act of the Legislature providing for its removal from Hanover to Durham. At the session of the Legislature of New Hampshire in 1866 an act was passed establishing the "New Hampshire College of Agriculture and the Mechanic Arts," on the basis of the congressional land grant, and authorizing its location in Hanover and its connection with Dartmouth College. In accordance with this act, the institution was organized under a board of trustees appointed partly by the governor and council, and partly by the corporation of Dartmouth College, the authorized connection with Dartmouth College was effected, and the institution was opened to students in 1868. Hon. David Culver, of Lyme, had provided for the college in his will, upon the condition of its location in Lyme. This condition was not accepted, and the estate had gone to Dartmouth College to be used for agricultural instruction.

ADVANTAGEOUS CONNECTION WITH DARTMOUTH COLLEGE.

This fact furnished one, and a strong reason, why the State College should be connected with Dartmouth College. This was more desirable by reason of the inadequate funds possessed by the State College. The 150,000 acres of the public land scrip was sold for $80,000 and the proceeds invested in state bonds yielding an income to the college of four thousand eight hundred dollars annually. Under these circumstances the offer made by Dartmouth College of the free use of its recitation rooms, museum, and library, and to allow its professors to give instruction in the new institution at the reasonable compensation of two dollars per hour, was considered a great inducement. Rev. Asa D. Smith, D. D., LL. D., president of Dartmouth College, labored long to bring about the connection, and afterwards, as president of the State College, showed himself a friend of the institution and its students.

The New Hampshire College was apparently the only one of the land grant colleges organized in connection with an older institution and yet dependent upon its own income, except the privileges and facilities furnished by the connection.

The first professor was Ezekiel Webster Dimond, who was made professor of general and agricultural chemistry. Dr. Thomas Russell Crosby was instructor in animal and vegetable physiology, which was the second professorship established. On the faculty list the names of six of the professors and instructors of Dartmouth College appeared as instructors in intellectual and moral philosophy, rhetoric and history, natural philosophy, civil engineering, mathematics, and gymastics.

At this time the College of Agriculture and the Mechanic Arts was considered a department of Dartmouth College, and so received most of its instruction from the college professors, or from students in its graduate courses.

Since 1877, the college has had an independent faculty, and has employed other

instructors only in exceptional cases. In 1878, the four members of the faculty gave nine tenths of all the instruction. In 1884, the five members of the faculty were giving even a larger proportion of the instruction. The number of the faculty was increased to seven in 1886, to eight in 1889, and to eleven in 1891.

Delay in Development of Training in Mechanic Arts.

In the first catalogue it was said of the courses of study, "It should be borne in mind that while agriculture, worthy of honor as the primitive pursuit of man, and as fundamental to the well being of every community, is to have a prominent place in the institution, the mechanic arts are also embraced." In mechanic arts the instruction had to be limited to theory, or turned into the lines of architecture and civil engineering. Almost from the first the need of a workshop was felt, and it was hoped that some friend of the institution would supply the deficiency. The beginning of the mechanical engineering course came, however, in 1886, when Thomas W. Kinkaid, assistant engineer, United States Navy, was detailed to act as instructor. He commenced the work under great disadvantages, and with few facilities. The lower classes, then in college, were given workshop instruction, and it has been given to all classes entering since 1886. At first, use was made of part of the carpenter's shop of Dartmouth College, but in 1887, a frame building, 30 x 30, was constructed near Conant Hall. In the following year the building was lengthened to fifty feet; and a boiler, engine, and considerable machinery were provided. Other machinery has been added, but the building itself has remained unchanged. Although Professor Kinkaid was connected with the college for two years only, he made the mechanical engineering course a prominent feature of the college. A course in electrical engineering was added in 1891.

In 1869, Professor Dimond stated at the annual meeting of the trustees, that all the possessions of the college were contained in seven boxes which he had brought from Europe. Whatever may have been the contents of these boxes there was no place ready to receive them.

To provide a suitable building for recitation rooms, and for other purposes, Dartmouth College offered to furnish $25,000 from the Culver fund, on condition that the State appropriate for the same purpose $15,000 more. The State accepted the condition, and preparations for the new building were begun in the fall of 1869. The corner-stone was laid in the spring of 1870, and Culver Hall was dedicated in the presence of the Legislature, June 23, 1871. The college purchased a field of about twenty-five acres opposite Culver Hall about the time its erection was begun, and later added another field adjoining, upon which Conant Hall was afterwards built.

Gift of Hon. John Conant.

The whole tract was connected with the farm purchased by Hon. John Conant of Jaffrey at a cost of $7,000, and given to the college. Mr. Conant suggested the provision of a suitable building of sufficient capacity to furnish rooms and board for students. Soon afterwards he proposed to give $5,000 for this purpose on condition that the State would provide the balance of the cost. The State made the necessary appropriation, the building was completed and opened for use in 1874, and appropriately named Conant Hall. Its probable cost was about $23,000.

These sums were but the beginning of the gifts of Mr. Conant. Later he provided the money to purchase additions to the farm, which increased the size of it to 360 acres. He also provided a scholarship for each town in Cheshire county, giving to the college in all more than $70,000.

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State Aid to the College.

The income from tuition was very small, and the only reliable income was that of $4,800 from the endowment. Up to the year 1875 the State had appropriated

$15,000 in addition to the $15,000 granted for Culver Hall. The cost of Conant Hall must have exceeded the estimates, and the erection of a large barn was begun in 1874, so that in September, 1876, the college was $7,000 in debt, and made application to the Legislature for further appropriations. In 1877, the State made an appropriation of $3,000 a year for six years. Of this $1,000 a year was to be used towards the payment of the debt; $1,000 a year for the salary of a farm superintendent; and $1,000 a year for the building of a new farm-house. In 1883, the State made an appropriation of $2,000 a year for two years; and in 1885, an annual appropriation of $3,000 was made perpetual.

In August, 1876, Jeremiah W. Sanborn was appointed farm superintendent. In his first report Mr. Sanborn called attention to the necessity of using the farm as an experiment station in order that it might be of the most practical benefit to the college. In that report he gave the results of feeding experiments, and he continued to report similar experiments to the trustees during his connection with the college. The work thus begun has been continued by the present professor of agriculture, Prof. G. H. Whitcher, who graduated while Professor Sanborn was superintendent of the farm.

When the college was opened to students the course of study extended through three years.

The attendance was gradually lengthened until, in 1889, a full course of four years was established. At the beginning, the requirements for admission were only the passing of an examination in the ordinary studies included in a common school training. These were rapidly increased till the announcement is now made that:

Commencing with 1892, the requirements in English are the same as those adopted by the New England colleges.

The Men to whom the Development of the College is Due.

No history of the college would be complete without some reference to those men, now deceased, who were identified with the interests and growth of the institution. Professor Crosby died March 1, 1872, and Professor Dimond in July, 1876. In January, 1877, President Smith tendered his resignation to take effect March 1, and died a few months later. Another early friend of the college, Hon. John Conant, died April 6, 1877, at the advanced age of eighty-seven years. His gifts to the institution entitle him to be called its greatest benefactor during its connection with Dartmouth College. Among the trustees who have given time and talents to promote the welfare of the college, Hon. George W. Nesmith ranks first. Elected president of the board of trustees after the resignation of President Smith in 1877, he held that office until his death in 1890, and by his energetic efforts and wise counsel carried the college through many difficulties; and it will be gratifying to his many friends to know that his memory is to be perpetuated by giving the name of Nesmith Hall to the new experiment station building at Durham.

It is fitting that the valuable services of Ex-Gov. Frederick Smyth should be mentioned in this connection. He has held the office of treasurer of the college from its organization to the present time, discharging its duties efficiently and to the benefit of the college, and all without compensation.

Importance of the U. S. Law Establishing Experiment Stations.

The act of Congress approved March 2, 1887 had an important influence upon the instruction given in the college. The annual grant of fifteen thousand dollars which this law made for the support of an agricultural experiment station, furnished means which the college had never possessed for doing thorough work in agricultural science. In place of one man, uniting more or less of the duties of experi-

menter, farmer, and instructor in agriculture and chemistry, there were several specialists, who, besides conducting the work of the station, gave instruction in the classroom. Instead of a farm partially equipped, there was one provided with model machinery and appliances. Previous to 1887 there had been considerable fragmentary instruction in agriculture; since that date there has been a steady progress in the college towards teaching agriculture as a science.

Value of the Additional Aid given by the U. S. Law of 1890.

If the reason is sought why the New Hampshire College more than any other institution has been benefited by the recent congressional legislation it is found in the increase of its income in 1890. On the twenty-ninth of August in that year the annual income from all sources, that would directly or indirectly affect the work of the college, was less than ten thousand dollars.

On the thirtieth of August, 1890, Congress passed an act granting fifteen thousand dollars a year to be expended for instruction and apparatus, and providing an increase of a thousand dollars a year until the limit of twenty-five thousand dollars should be reached. The establishment of the experiment station had given an impetus to one line of work; this large increase of income extended its influence to nearly every line of work which can be properly done by a scientific institution, as the money thus given is to be applied "to instruction in agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural, and economic science, with special reference to their application in the industries of life, and to the facilities for such instruction."

The Munificent Bequest which has led to the Removal of the College to Durham.

The bequest of the late Benjamin Thompson of Durham to the State, of his farm, known as the Warner farm, and his other real estate in Durham comprising a total of 253 acres, together with the sum of $363,000.82 in personal estate, awakened a new interest in industrial education, and the Legislature by an act approved March 5, 1891, accepted the munificent gift, and at once proceeded, by appropriate enactments, to provide for the removal of the New Hampshire College of Agriculture and the Mechanic Arts from Hanover to Durham, and for the construction of buildings and accommodations which should amply provide for the needs of the college in its new home, and be commensurate with the great endowment which will place it in the foremost rank of institutions of its kind.

The trustees, in obedience to the instructions and requirements of the act, approved April 10, 1891, took immediate steps to effect the removal of the college provided for in this act. All of the real estate in Hanover, owned by said college, has been sold at private sale for the sum of twenty-eight thousand dollars, ready cash, and arrangements have been made with the trustees of Dartmouth College for the re-payment to the State of the fifteen thousand dollars appropriated by it towards the erection of Culver Hall.

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As soon as the spring opened in 1892, work was begun for the erection of an experiment station building, a barn, a science hall, workshops, and boiler house, and the main building to contain an office, recitation rooms, library, museum, hall, etc.

These buildings are all of brick, with the exception of the barn, and all are expected to be completed on the outside before winter sets in. They are thoroughly constructed upon the latest and most approved plans. A steam heating plant is now in process of construction, which is designed to warm all the buildings from a central station, so as to secure to the occupants the most comfort and avoid the danger of fire.

* * * * * *

The careful and thorough examination of all the work by the Legislature, is cordially invited, and when that is done, no doubt is entertained that funds sufficient to complete the necessary work will be readily provided. The future prosperity of the college will depend upon its equipment and the manner in which it starts on its new career. Evidences are not wanting to show that with proper accommodations, the number of students will be large; and the future appears bright with promise of vastly enlarged usefulness for this institution. Since the last report, the college in Hanover has done good work, and the number of students has been about the same as in previous years. The removal has inevitably interfered with the ordinary work of the professors, and their duties have been more arduous than at other times, but on the whole it gives the trustees great pleasure to report prosperity in the present, and encouragement for a more prosperous work in the future.

LYMAN D. STEVENS,
President, in behalf of the Trustees.

The following statements, relating to the removal of the college and to the new work proposed when once the institution is settled in its new home, are the closing paragraphs of the report by the Dean of the College:

* * * In the work thus far carried out at Durham it has been the constant endeavor of trustees and faculty to so direct effort that future growth might add to, without tearing down, what has already been accomplished. To this end the fundamental essentials of substantial and convenient buildings, properly located and drained, well heated, lighted, and ventilated and supplied with an abundance of good water for use and protection, have received careful attention and work has gone forward in accordance with the advice and under the supervision of the best talent available.

The regular college work has moved on smoothly and successfully during the last two years. The Faculty has been strengthened by the addition of a permanent Professor of Mechanical Engineering, a Professor of Zoölogy and Entomology, and an Instructor in Modern Languages.

It was not to be expected that the number of students would be maintained, while the institution remained in Hanover, after the final decision in favor of an early removal to Durham. Hence it has been very gratifying to find the entering classes keeping nearly up to the average in numbers with no special effort in this direction. It is one sign out of many proving, what is evident to the observing eye, that the public appreciate the facilities, unequaled in the State, which the bounty of the national government is providing for the youth of New Hampshire and recognize the able and painstaking work of a Faculty selected from among the trained graduates of six of our leading institutions for the special work each member was able to do. All indications point to a large accession of numbers as soon as the college is moved to its new home next August.

PROPOSED ENLARGEMENT OF THE WORK OF THE COLLEGE.

Three points only require special mention at this time: 1. It is the unanimous wish of the faculty that, as soon as may be after removal, some of the benefits of our agricultural instruction may be brought home to a larger number than can be gathered together to take any of our regular courses of study. This desirable end may be attained by short courses in dairying, horticulture, etc., by lectures and institute work throughout the State, or by these several means combined. The sooner such work can be undertaken, the better for all parties concerned. 2. The opening of the doors of the college to women has already proved its utility, as ten young ladies have been enrolled either as regular or special students. 3. I desire to restate an opinion, given by me in the last report and strengthened by two years

of additional experience, "In regard to preparation for college, we desire that the advantages of the excellent academies and high schools, scattered over our State, may be enjoyed and utilized by those who propose to study here, in order that their progress after entering may be more rapid and satisfactory. It is generally unwise to hasten one's entrance under eighteen, at the expense of a thorough preparation." The young men and women who are to become leaders in the industrial life of New Hampshire rightly demand and expect the best facilities and instruction that money can procure. In justice to themselves, then, they should secure that preliminary training and maturity of thought which will enable them to fully utilize such advantages when offered.

C. H. PETTEE,
Dean.

The extracts from the report of the examining committee are here quoted for their suggestions relating to Drawing and Manual Training, and for their favorable comments on the admission of women students.

REPORT OF EXAMINING COMMITTEE FOR 1891.

To the Trustees of the New Hampshire College of Agriculture and the Mechanic Arts:

GENTLEMEN: The examining committee have, as far as practicable, attended the annual examinations and present their report.

We congratulate your board and the people of New Hampshire upon the prospect that the College of Agriculture and the Mechanic Arts will soon enter upon an enlarged sphere of usefulness that will be in some degree commensurate with the great interests which it specially represents. When we consider how large a portion of the people of this, or indeed any other State, are and must ever be engaged in agricultural or mechanical pursuits, and how absolutely essential, not only to the public welfare but to human life itself, these occupations are, then we appreciate the fact that a college which shall worthily represent and promote these interests must be amply endowed and in all respects thoroughly furnished. Happily the princely liberality of the late Benjamin Thompson and liberal appropriations by the Legislature of New Hampshire are now being combined with the present equipment of the college originally aided by act of Congress, for the purpose of placing the institution upon an enlarged foundation.

It cannot be doubted that this will awaken a new interest in the college on the part of the people of the State, and that it will take high rank among the educational institutions of New Hampshire.

HOW THE COLLEGE MAY BENEFIT THE COMMUNITY.

We should not overlook the many ways in which such a college may benefit the people. A liberal, generous culture with rational development of both physical and mental powers is a great need in every vocation of life. And in many special ways the College of Agriculture and Mechanic Arts benefits the people,—by its investigations concerning improved methods of tillage, the use of fertilizers, stock raising, dairy management, injurious insects, and other concerns of farm life; by the development of mechanical intelligence, engineering skill, and their applications to the various arts; by a comprehensive course of scientific instruction not excluding literary and other branches of learning.

HOW IT MAY PROMOTE THE PUPLIC HEALTH.

Having considered the course of study as arranged and finding in it the means of a broad and generous culture there are two suggestions which we respectfully submit for the consideration of your board. The first is, whether or not there may

be need of extending the study of sanitary engineering so as to include other branches of sanitary science. The preservation of the public health, by the proper isolation of those sick with contagious diseases, by the disinfection of households of those who may suffer from such diseases, by all methods which depend upon popular intelligence concerning the means of preserving the health, may well have consideration in arranging a plan of practical education for the people. Considerations of health, comfort, and economy alike suggest that the important concerns of sanitary science should have full recognition.

ELEMENTARY INSTRUCTION IN ARCHITECTURAL DRAWING SUGGESTED.

The second suggestion is, whether or not the study of mechanical drawing may well be so extended as to include the simpler elements of architecture. The designing of houses directly affects the health of the occupants. Large sums are often wasted upon poor designs. The improvement of the dwellings of the people is an object of serious importance. Household architecture should have consideration with reference to health, comfort, economy, good taste, landscape gardening, tree planting, etc.

THE COLLEGE OPENS ITS DOORS TO WOMEN STUDENTS.

Your committee notice with satisfaction the admission upon their application of Miss Lucy E. Swallow, of Hollis, and Miss Delia E. Brown, of Hanover, to the benefits of the college. Whether we consider the fact that the college is in part sustained by state appropriation, that agricultural and mechanical employments are concerns of both men and women, or the purpose of the college as defined by the act of Congress in pursuance of which it is established, the propriety of offering the advantages of the college to young women equally with men is apparent.

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The machine and carpenter shops were visited by the committee and were of interest, not simply for the mechanical knowledge and skill that may be acquired by their use, but as a means of physical development. It is said that* "in Germany, France, Sweden, Norway, and Switzerland physical instruction is compulsory in all schools." Manual training schools tend to secure physical development in connection with useful mechanical or other industry, for which the opportunity afforded by the college should be highly esteemed.

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LYMAN CLARK,
JOHN G. TALLANT,
DANIEL W. RUGG.
Committee.

The examining Committee for 1892, in their report to the Trustees, lay special stress on the general lack of suitable preparation of those seeking admission to the college.

REPORT OF EXAMINING COMMITTEE FOR 1892.

To the Trustees of the New Hampshire College of Agriculture and the Mechanic Arts:

Your examining committee for the year 1892, having carefully and conscientiously discharged the duty devolving upon them, beg leave to briefly and respectfully report as follows:

We are satisfied that the teaching in the New Hampshire College of Agriculture and the Mechanic Arts is as thorough and efficient as that of other colleges of its class, and of those giving what is termed a classic course of instruction. The

* N. A. Review June, 1891, article on Compulsory Physical Education.

natural sciences, which are of fundamental importance to both agriculture and the mechanical arts, are certainly in the hands of competent iustructors, who evidently feel a deep interest in their work and succeed in drawing out the enthusiasm of the students. In this line we witness no evidence of neglect or inefficiency, nor do we find any occasion to criticise one department and commend another. All appear to be doing faithful and satisfactory work.

By way of suggestion, we would call attention to the self-evident lack of thorough preparation on the part of the students to enter upon the college course. There ought to be some change in our common school system which will give to the scholars the fundamental or rudimentary principles, with the leading nomenclature, of the natural sciences. Or, in the absence of this, a short introductory course in the college, which need not prolong the entire period devoted to strictly agricultural and mechanic instruction, as foreign languages, and even history and literature, could be left for an additional term by such of the students as would desire to devote additional time to them. The recommendation of a careful perusal of such books as could be named, might be made to cover history and literature; while the prompt translation and publication of such things of value as appear in other languages would supply in a great measure any disadvantage arising from not having the ordinary smattering of these languages, which is usually soon lost on entering upon the serious and every-day duties of actual life.

Another point impresses itself upon our minds—and that is the lack in some departments of suitable text-books for use in a special course of agriculture and mechanic arts. The field is by no means well defined.

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T. D. CURTIS,
W. SCOTT WARD,
Committee.

HANOVER, *June* 24, 1892.

The following statement is from the opening pages of the catalogue for 1890–1892, which forms a part of the report by the Trustees.

At the session of the Legislature of New Hampshire in 1891, acts were passed severing the connection with Dartmouth College and removing the State College from Hanover to Durham; accepting the Benjamin Thompson estate, which was then of the value of more than four hundred thousand dollars, and accumulating at four per cent compound interest will be available as an endowment, in 1910; and providing one hundred thousand dollars to be used with certain other sums in the erection of buildings.

These buildings are so near completion as to make it certain that in September, 1893, the college work will begin at Durham, with shops, laboratories, and other facilities found at the best technical schools.

The necessary transfers will be made during the summer vacation, and will not interfere with the college work of the preceding or the succeeding year.

The following paragraphs from the statement of the conditions of admission, are of interest when one recalls that, only a few decades ago, it was possible to enter one of the best classical colleges, without any direct examination as to proficiency in English.

In English the examination will consist in the criticism of specimens of incorrect English, together with a short essay, correct in spelling, punctuation, division into paragraphs, grammar and expression, on a subject to be announced at the time of the examination.

Students are advised to prepare themselves thoroughly in all the required subjects and especially in English, since no college can be expected to admit students

who can not write their own language with neatness, clearness, and an approach to accuracy.

They are further recommended not to limit their preparation to these requirements. The excellent academies and high schools of New Hampshire put within their reach, a preliminary training which will add greatly to the value of a college course.

The following is the general summary of the required work in Drawing, and Shop-work; these are given in the different courses, and years, as already stated in the preceding pages.

DRAWING.

[Two hours and one half in the drawing room is reckoned as one exercise.]

1. Freehand Drawing.

(*a*) Copy Work and Sketching; thirty exercises.

(*b*) Shading and Tinting, followed by a short course on the care and use of drawing instruments; twenty exercises.

2. Descriptive Geometry and Drawing. Solution of problems in descriptive geometry; eighty exercises.

Course 2 is open only to those who have taken Mathematics.

3. Mechanical Drawing.

(*a*) Elementary Projection Drawing; twenty exercises.

(*b*) Perspective Drawing and Line Shading; twenty exercises.

(c) Workshop Drawings. Tracing and the blue process of copying drawings; thirty exercises.

SHOP WORK.

[Three hours' work in the shops is considered equivalent to one exercise.]

1. Work in Wood Shop. Exercises in carpentry, joinery, and pattern making.

(*a*), forty-five exercises; (*b*), thirty exercises; (c), forty-five exercises; (*d*), thirty exercises.

2. Work in Machine Shop. Exercises in bench work, machine work, and shop measurements.

(*a*), thirty exercises; (*b*), twenty exercises; (c), twenty exercises; (*d*), forty-five exercises; (*e*), thirty exercises; (*f*), thirty exercises.

Floor plans accompany the descriptions of the new buildings. The main building, a view of which is given as a frontispiece, is 128 feet in length by 93 feet in width, with a central tower and a porte cochére 40 feet in length; altogether a stately building of three stories, built of granite and brick. The Science building, 93 by 70, is also of three stories.

THE SHOP BUILDINGS.

The shops have been planned and built with the object of providing facilities for instruction in the working of wood and metals and in the design, construction, care, and management of machinery. Incorporated with the shops, is a central station for furnishing heat, light, water, and power, wherever needed in any of the college buildings; and the machinery of this station will form a part of the material equipment of the engineering departments.

The main shop building is 42 by 106 feet, and two stories high, with a basement 31 by 42 feet. In a separate one-story building 40 by 100 feet, on a level with the basement of the main building, are the boiler house, forge shop, coal shed, and foundry.

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On the first floor of the main shop building, a lavatory is provided, with lockers for the convenience of students. The largest room on this floor is the machine shop, where there will be opportunity for practice in the operations of working metals by cutting tools, both by hand work and by machinery. In the mechanical laboratory, the students may learn by actual tests the strength and other properties of the various materials used in engineering constructions; the lubricating value of oils, etc.

The second floor of this building is mainly occupied by a wood shop, in which the common branches of carpentry, joinery, and pattern making will be taught. Practice will be given in the use of carpenter's tools, and in the care and operation of the machines of most general use in wood-working. A well lighted corner of this room is partitioned off and will be equipped for copying drawings by the blue process. Two office rooms are also provided, one of which will be temporarily used as a recitation room, the other as a drawing room.

The shop buildings are constructed on the "slow-burning" principle, with thick walls, and heavy continuous plank floors. The rooms are all well lighted and well ventilated.

A handsome two story brick building, called Nesmith Hall, is occupied by the Experiment Station. Tuition is placed at $60 a year, but there are 54 scholarships, 30 of which pay the holder $40 besides the tuition; the remainder pay $20 more than the tuition. The annual expenses are estimated from $129.00 to $228.00. Total number of students connected with the college in 1891–'92, 61. The Faculty number 16 Professors and Instructors. Hon. Lyman D. Stevens is President. Charles H. Pettee, A. M., C. E., Dean, and Professor of Mathematics and Civil Engineering.

Rutgers Scientific School, Rutgers College, N. J.

"Rutgers Scientific School, The State College for the benefit of Agriculture and the Mechanic Arts," is known as the Scientific Department of Rutgers College, situated at New Brunswick, New Jersey.

This school, organized in 1864, in compliance with the United States Land Grant act, is also, by law, designated as the "State College;" and has forty free State scholarships, distributed pro rata among the several counties on the basis of their representation in the Legislature.

The courses are as follows: Two Regular courses of four years each, in "Civil Engineering and Mechanics;" and in "Chemistry and Agriculture."

Special courses of two years each in "Chemistry," and in "Agriculture;" also, optional post graduate courses. The studies of the two principal courses are alike for the first year, at the end of which the student elects which course to take; the studies thereafter are specially adapted to their purpose. Drawing is carried through each term of the four years in both courses. It is also taught in each year of the special course in Agriculture, but is not taught in the special course in Chemistry.

In the 17th Annual Report of the Rutgers Scientific School for the year 1881, made to the Governor of the State by the Trustees of Rutgers College, and signed by Rev. Wm. H. Campbell, LL. D., President both of the College and of the Board of Trustees, there is, in addition to an account of the instruction given in drawing the past year, a statement of the importance of elemental and thorough training in this study on the part of all pupils in the public schools, as well as in the technical institutions of a manufacturing community.

As this bears directly upon the subject matter of the present work, and shows the intimate relation borne by the primary schools to the higher and technical schools, these pages of the Report for 1881, are here quoted.

GRAPHICS.

During the past year, instruction in Descriptive Geometry has been given the Sophomore Class. A text-book was used in the recitation-room as a convenient method of bringing principles to the students' attention, and of discussing them. At the same time, problems prepared by the professor, and furnishing novel and practical applications of these principles, were assigned for solution in the draughting-room. These have proved of very great benefit, not only in giving a meaning to what might otherwise have seemed abstractions, but in familiarizing the mind with the relations and properties of geometrical magnitudes, and with the many artifices of solutiou which are invaluable to the draughtsman as well as to the descriptive geometer. The work of the year in this respect has been exceptionally satisfactory, the problems solved being more numerous and more difficult than those of previous years, and the solutions furnished possessing unusual merit in originality of method as well as in comprehension of principles. Many of the problems were more difficult than those assigned for the "Science Examinations" in England. The subjects of the Intersection of Surfaces, Shades and Shadows, and Linear Perspective were illustrated by problems which stimulated investigation and ingenuity on the part of the student. At the end of the year the growth in the power of synthetic and analytic reasoning was felt by the students themselves, and it was evident to the professor.

Instruction to the other classes was entirely oral, in connection with work at the draughting-table. During the hours devoted to this work, questions and discussions, either among the students themselves or with the professor are always in order and generally in progress. As a result, not only are methods learned, but also the reasons for them, with the occasion and effects of modifications. From this comes a more thorough mastery of the principles and a greater facility in their application. In short, the student grows into an intelligent and ready draughtsman. The work with these classes was in the construction of geometrical problems, topographical drawing, lettering, the use of colors and practice in shading, cutting of timbers, finished drawings, etc.

THE VALUE AND IMPORTANCE OF PREVIOUS ELEMENTARY TRACING IN DRAWING.

Attention has been called in previous reports to the great hindrance to the most effective work in this department, arising from the fact that very rarely does any new student coming here, except from the Rutgers College Grammar School, have even the most elementary knowledge of rightline drawing. The names of the most common draughting instruments are entirely unknown to him. Of course, he knows nothing of their purposes or of the manner of using them for the simplest

operations. Again would we protest to the people of the State, against this unnecessary waste of time,—in the curriculum and to the student—a waste which is the more to be lamented because occurring when opportunities afforded for advanced instruction, based upon the principles of mathematics and mechanics here taught, cannot be improved by reason of a want of elementary instruction in this subject. The possibilities of at least one year are lost from this cause. And since our students are preparing for various and dissimilar vocations, the arrangement of special courses in drawing, with reference to such vocations, and advanced instruction in these courses, is not to any great extent practicable, and the limited time available becomes, therefore, the more valuable. Besides, a few of the students, as indicated above, having had some instruction in elementary drawing, must either repeat the course or a difficulty arises in providing proper work and oversight for different members of the same class, which cannot be well met without increased teaching force and facilities. We feel interested in this question as an institution, for students coming to us are not ready to receive for themselves, and prevent the giving to others who are ready, the instruction which we could and desire to furnish; and we are thus hindered from accomplishing the full measure of results which we feel we might otherwise attain.

INDUSTRIAL DRAWING SHOULD BE TAUGHT IN THESE COLLEGES.

It seems proper that schools established for the benefit of agriculture and the mechanic arts, of which this is one, should encourage the art of drawing, particularly industrial drawing. There was a time when industrial education would have been regarded not only as an innovation, but almost as a heresy, even if the meaning of the term were understood. The importance of this education was greatly underrated; special training was provided, and large sums of money provided for young men who intended to enter the learned professions; but the young Wattses and Stevensons developed in a chilly atmosphere of neglect and indifference. It was only when the English public found the markets of the world, which they had sometimes seemed to regard as their peculiar heritage, occupied by France and other European nations, that they clearly perceived the necessity of promoting a system of thorough scientific education as the first ground work for material national prosperity. The lesson of the World's Fair of 1851 was a bitter one to English prejudice and tradition in education. Commercial prudence overcame ancient prejudice, and English manufacturers regained their place in the world's market when English money and care founded and fostered the South Kensington, and the many other schools for industrial education.

NEED OF TECHNICAL INDUSTRIAL ART TRAINING RECOGNIZED.

In this country, the General Government, some of the State Governments, and several private citizens have, in recent years, aided in the establishment of many similar institutions. Such schools are evidences of the need felt by their founders, many of them practical business men and manufacturers, for a trained labor, and of their sense of the necessity of providing suitable opportunities of imparting the desired education. Business men are the first to see the business needs of a State, and to provide for them. In promoting industrial education, they simply take money from one pocket to secure an increased return into the other. Recently a representative of one of the leading industries of a large manufacturing city in this State was induced, by his sense of the needs and his appreciation of the advantage of industrial drawing in his business, to propose the offering of prizes to the pupils in the public schools of this city, for the best designs for oil-cloths, table-cloths, wall paper, etc.

We may safely say that the mills of Massachusetts would never have achieved their present reputation but for the school-houses; that the system of training in

industrial drawing, and of industrial education generally, so well developed and so efficiently conducted in that State, has made possible the improved machinery and increased skill, whose products are held in so high repute. The State law, which makes it possible for all cities or towns of five thousand inhabitants, and obligatory upon all of more than ten thousand, to "annually make provision for giving free instruction in industrial or mechanical drawing," etc., has given the wheels of those mills a new impetus.

In all institutions devoted to industrial education, industrial drawing is regarded as one of the principal supports or most essential factors in the system. And just here it may be well to meet an objection to the introduction of drawing into all schools, by indicating what we deem the proper character to be given to this drawing.

INDUSTRIAL DRAWING DEFINED.

Industrial drawing is not what may be called aesthetic drawing. Its object is not to make "pictures." In the latter, the artist aims to represent a combination of objects, real, imaginary, conventional or conventionalized, for the purpose of producing a pleasant effect upon the eye and mind of the beholder. Its purpose is artistic or "effect." In industrial drawing the draughtsman aims to represent primarily, forms and relations as they are in the object represented, existing or to be produced. Its purpose is utility or "service." When this principal object has been attained the decorator may and does add such lines of figure, or other design, as shall increase the beauty of the object, while consonant with its purpose but never interfering with it.

Drawing is too often regarded as an accomplishment merely, without possessing any really practical value. The apathy manifested in many instances when it has been proposed to introduce this subject as one of the regular branches in the school curriculum, gives unfortunate indication of the mistaken notions too prevalent of its scope and purposes. And if allowed a place in the course, it is generally assigned a position such that teachers, pupils and parents understand that it is "of little account;" but the instruction in drawing, which we advocate, which we should be gratified to see introduced into every school in the State, and which we give in this "State College for the Benefit of Agriculture and the Mechanic Arts," so far as the facilities furnished us allow, which we feel is essential to the highest development of any manufacturing interest—industrial drawing—furnishes not only bread and butter in any community, but in one whose manufacturing interests are great it provides strong meat out of which are formed the bone and the muscles of a strong and efficient body of industry. The duty of the State toward its children, its future citizens, is to make, or assist in making, them as efficient as possible factors in diminishing waste of its economic possibilities, in husbanding its resources, and in increasing its wealth.

EDUCATIONAL VALUE OF DRAWING.

Drawing has an educational value, which is universal in its character. It develops closeness of observation, accuracy of perception, vividness of imagination, quickness of eye, facility of hand, care and judgment in expression. It cultivates a knowledge of relations, of fittingness and adaptation—all useful in the general duties of life, and which render their possessor either better producers or better fitted to appreciate the products of labor which was guided by this training.

MONEY VALUE OF DRAWING TO THE STATE OF NEW JERSEY.

There are few States in the Union in which the subject of Industrial Drawing is so important as in New Jersey. Her varied industries make constant demand upon the designer and draughtsman. The last report of the Bureau of Labor and Sta-

tistics of the State gives $82,871,863.12, as the value of the manufactured products in those industries where drawing is essential to accurate work and prevention of waste, and $20,528,017.30, as the amount of wages paid to laborers in those industries. To this should be added the values of buildings erected, bridges built, railroads, steam and other boats constructed, none of which are included in the report, and the sum assumes a magnitude which makes the neglect of anything tending to conserve and promote the efficiency of these interests seem culpable.

Industrial Drawing is one of the most important links, binding together and showing the relation between the school and the practical industries of the country; giving, more than most others, direct and appreciable results of the training of the former upon the products of the latter. It is scientific, artistic and educational; scientific to properly secure the accuracy of permanent and economic workmanship; artistic, to add the enhancing quality of beauty of form or decoration to the products of that workmanship; educational, in the training of the faculties which it gives; and it is always practical.

The Department of Graphics in this institution aims to assist in securing for and to the industries and people of New Jersey the benefits which are possible for them in this branch of education."

The report shows an attendance of 46 students during the year ending Dec 31st, 1881.

In the Twenty-Seventh Annual Report,* made by the State Board of Visitors and by the Trustees of the School, for the year ending December 31st, 1891; the fact of the passage of the law on March 31, 1890, "establishing a free scholarship for each assembly district each year," is recorded, and the conditions given.—The Trustees had, in 1888, increased the 40 State "county" Free Scholarships by the addition of 10 more, "at large." These were all reported as filled.

The following is the course of study offered in this School.

COURSES OF STUDY AND DEGREES.

Six distinct courses of study are included in the schedule which follows:

I. *A Course in Agriculture.*
II. *A Course in Civil Engineering and Mechanics.*
III. *A Course in Chemistry.*
IV. *A Course in Electricity.*
V. *A Course in Biology.*
VI. *A Winter Lecture Course in Agriculture.*

During the first year the studies of the five full courses are nearly the same, and are designed to furnish a suitable introduction to the pursuit of the higher branches in either.

At the end of the first year students elect to pursue one of the five full courses, and for the remaining three years their studies are directed with particular reference to the choice made. Some studies which go to the equipment of the intelligent citizen, whatever his occupation, such as History, English Literature, Political Economy, Political Ethics and others, are interspersed throughout the entire four years, in order that students may not only acquire a thorough preparation for their special pursuits in life, but may at the same time receive a liberal training which will fit them to discharge wisely and usefully the duties of good citizenship.

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* Twenty-Seventh Annual Report of Rutgers Scientific School. The State College for the benefit of Agriculture and the Mechanic Arts, New Brunswick, N. J., for the year 1891. Trenton, N. J., The John L. Murphy Publishing Company, Printers. 1892. Pp. 104.

Provision is also made for Special Students, who may enter at any time, and elect, under the advice and direction of the Faculty, such studies as they may be found qualified to pursue with classes already formed. Such students are subject to the general regulations and discipline of the institution. They are required to have their time fully occupied, and to pass such examinations as may be prescribed in each case. On leaving, they receive certificates stating the studies pursued and the amount of work performed in each.

Drawing is required in all the courses for the first two years; and in all others, except the courses in Agriculture, Chemistry, and Biology, through the four years.

The following statement describes the methods adopted in teaching Drawing.

II. GRAPHICS.

The instruction in this department is oral and by illustration or supervision, except in Descriptive Geometry. In this subject a text-book is used in the recitation-room, while the principles there discussed are more fully illustrated by problems assigned for graphical solution in the draughting-room.

During the entire course of four years the students are required to spend a certain number of hours each week in the draughting-room in practical work in Drawing. In the Freshman year the practice begins with the use of the principal instruments employed in Mechanical Drawing. This practice is obtained in the solution of problems in Plane Geometry, thus securing two ends, viz., a knowledge of the purposes of the instruments and of the manner of using them, and a knowledge of geometrical principles and their applications, particularly such modifications and applications of the principles as will give the shortest, neatest and most perspicuous methods of working. When the student has acquired some facility in the use of instruments, he is taught the methods of Topographical Drawing with practice in the use of colors, pen-signs, contour-lines, etc. Also, the methods of Graphical Representation of Statistical Data. At the end of the first year's work, the student has had instruction sufficient to enable him to execute all the drawings required in Plane Surveying for farm purposes, etc.

In the Sophomore year, the course in Drawing is based on Descriptive Geometry, as that, at the beginning of the Freshman year, exercised the student's knowledge of Elementary Geometry. Besides the solution of problems in Solid Geometry, the course, during the year, includes practice in Shades and Shadows and Linear Perspective, the work being all directed by mathematical principles.

During the Junior and Senior years, the aim of the instruction is to acquaint the student with some of the many applications of the principles of Drawing additional to those in which he has had practice in the first two years. The limited time allowed to the subject, and the diversity of the intended pursuits of the students after graduation, prevent extended practice in any particular department of Drawing. The design, therefore, is to prepare intelligent and ready draughtsmen, familiar with fundamental principles and methods; men who in any of the mechanic arts or in farming will be able to sketch machines and apparatus, and will be valuable assistants in the draughting-room of the architect or engineer, rather than accomplished masters in these professions; to give the student a safe beginning on which to grow more easily and surely into the work of the practical designer.

Total number of students in attendance 134; of these, 7 were "special" and 4 "Post Graduate."

The Faculty consists of 26 Professors and Instructors. Austin Scott, PH. D., LL. D., President, and Professor of History and Political Science.

CHAPTER XII.

UNITED STATES LAND GRANT COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS—Continued.

This University was incorporated by the Legislature in 1865, and designated to receive the income of the United States Land Grant Fund—How Mr. Cornell, preserved and augmented that fund is well known—The University opened in 1868—The Department of Agriculture, is the only one considered in this chapter—Other departments in which drawing enters; "Engineering," "Architecture," etc., have kept pace with the growth of the University, and will be recorded with like institutions elsewhere in this report—There is a farm of 200 acres, the gift of Mr. Cornell, attached to this department—A course of four years leads to a regular degree—There is also a course of three years without a degree—Drawing is taught two terms of Freshman year in the first course, and only one term in the last—Free-hand drawing as taught in the University—Equipment for instruction in Drawing—The Register of the University for 1881–'82, shows an attendance of 384 students—President Adams' Annual Report for 1891–'92, shows that, while the number of students in the University as a whole, has greatly increased, attendance in the Department of Agriculture has rather diminished—As in many other institutions, the number of students of Agriculture are relatively few—The work here seems largely that of educating Professors and Teachers—Extracts from this report—Agricultural institutions—The report by the Director of this College commends enthusiastically the work in the Experiment Station—General view of the course in Agriculture, in the Register for 1892–'93—A winter course of eleven weeks offered for the first time—Out of a total of 1,665 students enrolled in the University for the year 1892–'93, 22 only, are enrolled in the College of Agriculture—The Body of Professors, Instructors, etc., attached to the University numbers 145—The Corps of the Agricultural Experiment Station numbers 13—Isaac Phillips Roberts, M. AGR., Director of College of Agriculture—Jacob Gould Schurman, D. SC., LL. D., President of University.

Regular course of four years—Twelve Departments of Study—Instruction in Drawing essential to study of Military Engineering—In 1881–'82, an attendance of 191 cadets—The admirable situation of this National Training School—Character of scenery—Historical Associations—The training here given valuable in peaceful pursuits as well as in war—President Thompson's estimate of this as a school of engineering and technology—In 1891, 261 cadet pupils in attendance—Academic staff numbers 58 Professors and Instructors. Col. John W. Wilson, Superintendent in 1891—A military staff of 17 officers.

CORNELL UNIVERSITY, ITHACA, N. Y., COLLEGE OF AGRICULTURE.

This well known institution owes its origin to the bounty of Ezra Cornell, who gave to it the sum of $500,000; and to the 1862 Land Grant Act of the United States.

In 1865, the Legislature of the State of New York incorporated Cornell University and appropriated to it the annual income arising from the funds accruing from sale of the land given by the United States grant. In addition to the departments required by the conditions of the United States Land Grant Law, the University is chartered to teach "such other branches of science and knowledge" * * * "as the trustees may deem useful and proper." The act of incorporation provides that one state student from each assembly district may here receive free tuition.

The University was opened in October 1868. It has fourteen separate Departments with Special Faculties.

As a full account of those Departments of the University, in the courses of which drawing largely enters, will be found elsewhere in this Report grouped with similar schools; only such facts as relate to the Department of Agriculture, are here given. This Department has a farm of 200 acres, which, with its buildings, was given by Mr. Cornell, in excess of the $500,000 mentioned above.

There is a four years course entitling to a Degree of Bachelor of Agriculture, and a three years course not leading to a degree. Freehand drawing is taught through the first two terms of the first year in the regular 4 years course, but only in the first term of that year in the 3 years course.

The following is from the University Register of 1881–82.

FREEHAND DRAWING.

Instruction in Freehand Drawing is given by means of lectures and general exercises from the black-board, from flat copies, and from models. The work embraces a thorough training of the hand and eye in outline drawing, elementary perspective, model and object drawing, drawing from casts, and sketching from nature.

The effort is, not to make mere copyists, but to render the student familiar with the fundamental principles underlying this art, and to enable him to represent any object he may desire correctly and rapidly. The course is largely industrial, and the exercises are arranged, as far as possible, with special reference to the drawing required in the work of the different departments.

All students in the departments of Agriculture, Architecture, Civil Engineering, Mechanic Arts, Mathematics, and Natural History devote two hours a day to freehand drawing during the first two terms of the first year; and students in Architecture, in addition, two hours a day during one term of the second, and one term of the third year. Students in the other courses may take drawing as an elective study.

EQUIPMENT.

The department has a large collection of studies of natural and conventional forms, both shaded and in outline; of geometrical models, and of papier mache and plaster casts, including a number of antique busts, casts of parts of the human figure, studies from nature, and examples of historical ornament."

The "Register" of the University for 1881–82, shows a total attendance of 384 students.

PROSPERITY OF THE UNIVERSITY IN 1892.

The "Annual Report of President Adams, for the academic year 1891–1892,"—shows in the general statement made by himself, and in the detailed reports made by the heads of the different departments of the University,—that, while in the total number of students attending, the University has grown enormously; and, while the increase of attendance in the Mechanical Engineering, and strictly Scientific courses, has kept pace with this growth; the attendance upon the College of Agriculture, has rather diminished than increased. In a table showing the totals of attendance during each of the seven years of President Adam's Presidency, it appears that, while the sum of students has increased from 575, in 1884–'85, to 1538, in the year 1891–'92, the pupils in Agriculture in the first of these years numbered 20, while in the last they are only 22, the highest number in attendance at any time during these seven years, was during 1888–'89,—when 37, are recorded. In treating of the College of Agriculture the President, referring to the small number of students definitely enrolled in this department, says:

The number of students in the Department of Agriculture continues to be relatively small. This is no doubt owing to the fact that agriculture as an industry has been in a very depressed condition and that the sons of farmers, having the means and the desire to pursue a thorough course of study have, for the most part, chosen to devote themselves to some other vocation. Another consideration is worthy of notice. We should not forget that, unlike most agricultural colleges in the country, the one here established is almost purely a technical school. Its design is to educate young men to be farmers in a large sense of the term, or to be teachers of some one of the branches of agriculture in an agricultural college. In a former report I

called attention to the fact that generally in the Agricultural Colleges, students are received who desire to study the Mechanic Arts, Civil Engineering, Botany, Natural History, and General Chemistry. The students desiring these general courses when coming to Cornell University are elsewhere enrolled, and therefore, while they swell the number of students in other departments, deplete the record of those forming a part of the College of Agriculture. It must also be borne in mind that all the Professors in the College of Agriculture, with two exceptions, devote most of their time to giving instruction to students not enrolled in that course. It may fairly be said, therefore, that the College of Agriculture requires by its presence no more than two professors and three or four subordinate teachers more than would be required if there were no department of Agriculture at the University. The bearing of this condition of affairs on the duties of the University is obvious. It has frequently been thought that thelarge expenditures of the Board for the department of Agriculture have not been adequately appreciated by the farmers of the state. It is perfectly true that the laboratories and libraries of the University are at the service of students in this important department; but I think we should make a grave mistake if we were to suppose that we ought to reduce our expenditures for that department in consequence of the smallness of the number of students actually enrolled in the College. A very large proportion of the students who come to the University, whether enrolled in the department of Agriculture or not, are the sons of farmers. It has often been truly said that this University, not only by means of the original Morrill Grant, but also by means of the supplementary Morrill Act and Agricultural Experiment Station fund, came from an impulse that had its origin and its support in a desire to benefit the agricultural interests in the country. Our function in the College of Agriculture seems to have been very largely to educate professors and teachers, and, notwithstanding the smallness of the number of students enrolled in the College, it is probable that no other department in the University can now show so large a list of Alumni who have arisen to distinction in their respective vocations. In view of these facts, the University, in my judgment, ought not to allow itself to be tempted into a policy of diminishing its appropriations for the department of Agriculture.

The report made to the President by the Director of the College of Agriculture, who is also Director of the "Experiment Station," is given wholly to details; these include all matters relating to Instruction and to those concerning the Farm, Stock, and Buildings. He is enthusiastic over the work done at the Experiment Station, which last he claims, attracts post-graduate students from all over the country.

The following is the opening paragraph of his report:

REPORT OF THE DIRECTOR OF THE COLLEGE OF AGRICULTURE AND OF THE AGRICULTURAL EXPERIMENT STATION.

To the President of the University:

SIR: The College of Agriculture completes the year in a most prosperous condition. Four new courses of study have been offered in the Department of Applied Agriculture. The students have readily availed themselves of these added opportunities for instruction in specific lines of work, and this work, although new, has been entered upon with great zeal by students and assistants alike. As the College grows from year to year, and the number of courses offered increases, the facilities for giving instruction become more and more inadequate. The rooms available for applied agriculture and the Experiment Station are entirely inadequate. It is hoped that some provision may be made at an early day to meet the wants of these departments in this direction.

The "Register" * for 1892–'93, in showing the general courses of teaching in the several departments, says of the course in Agriculture as follows:

The instruction in the College of Agriculture is comprised in the following general lines:

Advanced or graduate work in Agricultural Science. This instruction is designed to fit men for teachers and experimenters and it may lead to the degrees of Master of Science and Doctor of Science. The laboratories are well equipped for the prosecution of independent work of a high character.

The Regular Course in Agriculture covers a period of four years. It is designed to afford an education as broad and liberal as that given by other departments of the University, and leads to the degree of Bachelor of Science in Agriculture. During the last two years of his course, the student selects his studies in those departments in which he is most interested.

The Special Course is intended for young men who cannot well spend four years in preparing themselves to become farmers and who yet wish to avail themselves of technical, practical instruction in modern scientific agriculture. Young men who are eighteen years of age and who have a fair knowledge of the common English branches are admitted to the Special Course without examination. They may stay for two years and are required to take lectures and recitations to the amount of twelve hours per week, from the list of elective studies of the Regular Course. The remainder of their time, three to six hours per week, they may devote to any studies which they are prepared to pursue. Special students, during the time they are in the University, enjoy equal advantages in all respects with students who are studying for a degree. They are admitted by a vote of the Faculty upon recommendation of the Director of the College of Agriculture, and applications for admission to the Special Course should be made personally or by letter to the Director of the College.

The short Winter Course is now offered for the first time. This course will be given for the first time during the winter term of 1892–3. It will extend through one term of eleven weeks, beginning Jan. 3, 1893. It is intended to meet the needs of those who have only the time and means to spend one or at most two terms at the University. Persons who are of good moral character and sixteen years of age, upon application to the Director of the College of Agriculture, may be admitted to this course. The instruction offered will be designed especially to meet their needs.

"Dairy Husbandry," "Animal Industry," "Poultry Keeping," and "work in the Experiment Station," are different divisions of study. There is a fine Dairy House, and a very complete Agricultural Museum. Horticulture is given in seven different courses," "Veterinary Science" is taught; there is also a Museum of Veterinary Science. The regular four years course in Agriculture leads to the Degree of Bachelor of Science in Agriculture.

Out of the 1665 students enrolled in the University during the year 1892–'93; 22, are enrolled under Agriculture, Teachers in University 145, Corps of Agricultural Experiment Station, 13. Jacob Gould Schurman, D. SC., LL. D., is President of the University, and Isaac Phillips Roberts, M. AGR., is Director of the College of Agriculture, and Professor of Agriculture.

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* The Cornell University Register December, 1892. "I would found an institution where any person can find instruction in any study." Ezra Cornell. Ithaca, N. Y. Published by the University Press of Andrus & Church. Pp. 237.

UNITED STATES MILITARY ACADEMY AT WEST POINT, NEW YORK.

The courses of instruction in this Government Training School for the future officers of the Regular Army, are divided into twelve Departments; each with their special corps of instructors. The full course of study occupies four years.

The corps of Instructors of the Department of Drawing, consists of a Professor, an assistant Professor, and two acting assistant Professors.

A practical knowledge of drawing being as inseparable from the training of a military engineer, (as essential to the Art of War as to the Arts of Peace,)—as it is to that of the Civil and Mining Engineer.

In the official schedule of courses of study, Drawing does not appear till the second year of the course ("Third Class"). In that year "Topographical drawing," is taught, as well as the "Construction of various problems in Shades and Shadows, Linear Perspective and Isometrical Projection."

In the third year, ("Second Class") "Landscape," "Pencil and Colors." In the fourth year, ("First Class") under the Department of "Civil and Military Engineering and Science of War."

"Mahan's Industrial Drawing," is given as one of the books of reference.*

There were 191 cadets in attendance for the year 1881–82.

BEAUTY AND HISTORIC INTEREST OF THE SITE OF THE ACADEMY.

This famous military school, whose history is inseparable from that of the Nation, is exceptionally fortunate in its local position and surroundings. Occupying a plateau, high uplifted above the stream on the west bank of the Hudson, just below the point where the lordly river, emerging from the mountain fastnesses,—whose frowning heights seem to the southward voyager about to bar effectually its passage—flows with calm current on its unimpeded way to the Ocean; it commands a prospect, world-renowned for noble beauty. From its commanding position, once held as a stronghold of power, whose possession was eagerly coveted by contending armies; it has long since, for the purposes of war, ceased to be of strategic importance. The broad expanse and circling sweep of horizon it commands is, however, no narrower now than when, from its secure heights, it dominated the river; and barred the pathway to the upper and lower waters of the Hudson.

If character, is, indeed, as some claim, insensibly but effectively influenced and moulded by natural surroundings, then, to those

*An account in detail of the instruction in drawing as given to the Cadets, will be found on pages 91 and 92 of "The U. S. Art Directory Year-Book, 1882, compiled by S. R. Koehler. The Academy has a collection of plaster casts from the Antique and a few Water Colors, open to the public.

dwelling in the presence of these scenes, where Nature is shown in some of her grandest features, where mountains, and stream, and far stretching horizon, combine to fill the mind with images of power and beauty, there should surely be an ennobling influence. However this may be, the spot seems to possess an undying charm for those whose four shaping years of youth have there been passed; and the old officers of the Army return to it with unaffected pleasure.

Historically associated with that tragic event of the Revolution, the well-nigh successful treachery of Arnold, and the consequent capture and death of Andre, this renowned spot has for more than a century, been the home of the one school for the army.

The officers here trained have upheld its fame for generations of graduates, from those distant days when a glorious record was made by the heroes of the war of 1812, and again, in the contest with Mexico; then through all the years remote and near, of the continuous conflicts with savages, waged along the borders of the wilderness ever receding before the encroaching tides of emigration—conflicts witness to many an heroic action unknown to the world. In later days, the deeds of gallantry and daring, wrought in the sight of all men, by those who were arrayed in hostile camps during the tempestuous years of Lincoln's administration; gave added proof of the efficiency and value of the technical training here received. This is the training in the Arts of War; but it would be an injustice to this school if its value to the Country, were only to be measured by its efficiency in training soldiers. In a peaceful country such as is the United States, in which, unlike many other lands, wars are but accidents, while the Arts of Peace are permanent; the educational value of such an institution is by no means to be limited to the training it affords in the Arts of War.

The Academy a Notable School of Engineering.

All Engineering Knowledge may be made as serviceable to the arts of peace as to those of war, and it has happened, during the long years of peace, that many of the graduates of this school have passed most of their lives as peaceful citizens; busily engaged as engineers in developing the material resources of the country, in various enterprises. In addition, many a youth who fails to graduate as an officer, becomes more or less well grounded in the elements of a technical education, and enlists in the ranks of the civil industrial professions; so that it may fairly be concluded that the Academy at West Point, besides training the officers of the regular Army, contributes a full quota of trained and competent engineers to the peaceful professions of Industry; and is, for this additional reason, of substantial worth to the Country.

The efficiency of this school, for the technical training of Engi-

neers, was incidentally set forth by the late President Charles O. Thompson, in his inaugural address on the occasion of his induction, in 1883, as President of Rose Polytechnic Institute. President Thompson, whose early death a few months later, has not ceased to be regretted by those who know of his rare gifts as an educator, had for fifteen years devoted himself with remarkable success to the development of the Worcester County Free Institute. Called to undertake the Presidency of this new institution, he had made a thorough preliminary inspection of the leading Schools of Technology in Europe, and was, also, familiar with all similar schools in the United States. In his discourse, while tracing the rise and development of institutions for the technical training of Engineers, he said:

The first independent polytechnic school was the Ecole Polytechnique in Paris, founded in 1794. The Ecole Centrale followed, and during the first quarter of this century similar schools were established all over France, Switzerland and Germany. In this country, *the best appointed* and on the whole, the most worthy of study as far as methods go, is the Military Academy at West Point; then we have the Columbia School of Mines, at New York; the Sheffield, at New Haven; the Rensselaer, at Troy; the Institute of Technology, at Boston; the Stevens Institute, at Hoboken; and many others. These are examples of pure and independent schools of Technology, each with a special end of its own, but possessing all the generic features of the class. They all arose from the demand for engineers in the arts of peace and of war. To this list must be added the state colleges of agriculture and the mechanic arts, several of which have made provision for effective teaching in engineering. The polytechnic school has always offered to the qualified average boy a good education based on drawing, the mathematics, the living languages and the physical sciences, tending to qualify him for immediate entrance upon the duties of an engineer. The course of study in a polytechnic school is determined by long experience and in all countries is substantially the same.

According to the latest "Register"* at hand, that for 1890–'91, the number of cadets in attendance at this National Military School was 261, showing a large increase over those registered in 1881. The number of instructors in the "Department of Drawing," however, remains the same; and consists of one "Professor," one "Assistant Professor," and two "Instructors." Colonel Charles W. Larned, who has held the position since July 25th 1876, is the Professor in charge. The "Academic Staff," numbers Fifty-eight Professors and Instructors.

There are eleven "Departments" of study, each with its separate corps of Instructors. Colonel John M. Wilson, Colonel of Engineers, is the "Superintendent.' He has a "Military Staff," of seven Army Officers.

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*Official Register of the Officers and Cadets of the U. S. Military Academy, West Point, N. Y., June 1891. Pp. 40.

The Agricultural and Mechanical College of the University of North Carolina.

PRELIMINARY WORDS.

The interest attaching to the resurrection of this historic institution, for which provision had been made when the constitutional existence of the State itself began, and which had suffered so cruelly from the vicissitudes incident to the "war of the rebellion"; and again suffers loss, owing to recent changes in the public opinion of the State which have at length resulted in the Legislative divorce of the Land Grant College from the University; combined with the interesting and able discussion by President Battle, of the intent of Congress in creating the Land Grant Colleges, a topic of very general interest, have led to the giving in this volume of unusual space to the accounts of this University, and of this College, both during its connection with the University and, more especially, to the details of the equipment and plans of the College in its new home in the Capital of the State.

Brief Historical Statement.

The Agricultural and Mechanical College of the University of North Carolina, is situated at Chapel Hill, 28 miles from Raleigh.

This location was chosen for the University for its salubrity. The University, which was provided for in the Constitution of the State adopted in 1776, was chartered in 1789, and opened for students at Chapel Hill in 1795.

The civil war of 1861–65 dispersed its students and in a great measure destroyed its endowments. The University was closed in 1872, but reopened in September, 1875.

The law of 1867, provides that

> "In order to promote the liberal and practical education of the industrial classes of the State, pupils may be admitted to the branches of Agriculture and Mechanic Arts who possess the requisite qualifications for these studies, without the previous literary training requisite for admission into the regular college courses."

The University when reorganized from what was practically, in its Academic Department, simply a classical college, was put on the more comprehensive plan which the term University implies. It now provides three separate courses, "Classical," "Philosophical," and "Scientific," known as "Colleges," comprising one or more "Schools." An optional course is so arranged that students unable from any cause, to take a full symmetrical course of general training, "may obtain purely agricultural instruction in branches deemed of special value." In the Scientific Course, Drawing is taught through the first year. In the College of Engineering, Drawing occupies a prominent place in the schedule of studies for each year of the three years' course, including working drawings of

buildings and machinery, topographical map drawing, Perspective Drawing, etc.,—The catalogue of 1881–82, shows a total University attendance of 199 students, 47 of these are "optional students."

Brilliant Inauguration of New Memorial Building.

Ten years subsequent to the re-opening of the University to students after the long interregnum caused by the exigencies of war, the quiet upland village of Chapel Hill, and the classic groves of the University, were invaded by a great gathering of the Alumni; who had come together to honor by their presence the opening of the large building erected to the memory of a revered former President of the University, David Lowry Swain, an Ex Governor of the State, who, for thirty-three years, had guided the course and presided over the fortunes of the University.

The corner stone had been laid with appropriate ceremonies on the 25th of September 1883.

The completion of the building was now, in the early summer of 1885, to be celebrated with equal ceremony. The Governor of the State, and the full board of trustees, were present to meet a distinguished and brilliant assembly of Alumni and citizens gathered from all parts of the State.

The Addresses.

After the usual opening ceremonies and the reading of the dedication ode, and a prayer, "Mr. Paul C. Cameron, chairman of the Building Committee, in behalf of himself and his associates on the committee (Messrs K. P. Battle and John Manning)," made the presentation address on delivering the completed building to His Excellency, Governor Scales, *ex-officio*, President of the Board of Trustees.

Opening his address with a statement that it was unusual for one to be called, as he had been, to a University rostrum sixty years after he had graduated; he proceeded to deliver a most interesting historical address—first giving an account of the life of President Swain, and of his administration of the University, and then reciting how it had come about that this memorial building was substituted in place of the monument at first proposed. Governor Scales, in his response, stated a fact to which the previous speaker had not remotely referred, namely: that to Mr. Cameron's energy and liberality was owing the funds needed to complete the structure.

Resolutions of thanks to Mr. Cameron, were accordingly passed at the close of this meeting; which was ended with the singing of the University Ode, written by Mrs. Cornilia Phillips Spencer.

The Building.

The Architect, Mr. Samuel Sloan, had unfortunately sickened and died, owing to undue exposure to the sun in his supervision of the building at an early stage of its erection.

The building itself is unique and, in its exterior, suggests the great audience tents of the perambulatory summer circus; only it has low walls of brick in place of the sheets of canvass; these walls are strengthened by frequent buttresses each side the large pointed arched windows, which latter seem almost to compose the walls of the structure, the brick work serving but as the frames of the windows. The front, with the round arch of its windows, and the square towers topped with low octagonal turrets, seems to have little organic relation to the rest of the structure, but serves sufficiently the purpose of an entrance. The interior of this building, like its canvass prototype, offers an almost ideal audience room; this is a circle of 128 feet in diameter, with not a column to interrupt the view. 2450 people can be comfortably seated. It is used for the commencement exercises, for which it is admirably adapted.

This building, begun as a memorial of President Swain,—in lieu of the erection of an obelisk on the campus,—had become a veritable Valhalla, a temple dedicated to the memory of the distinguished graduates of the University, whose names were to be seen inscribed on tablets of stone inserted in the walls.

Significance of Such Memorials.

These names, once borne by the illustrious sons of the University, and of the State, furnish, in themselves, glorious proof of the greatness of the State, and give enduring evidence of the service rendered to the Commonwealth by such Institutions of Higher Learning; while they are an ever living well of inspiration to the annual throngs of ingenuous youth who come, year after year, to enroll their names in the lists of students and to emulate their predecessors.

A Roll of Honor, which has been growing for an hundred years; and on which are found the names of many, honored alike in the annals of the Nation, as in those of the State.

To be adopted into such a family and endowed with such an ancestry, may thus be the proud privilege of the humblest child of the State. Who shall measure the extent of this silent influence, in elevating and ennobling character? Certain it is that a Stranger, having no personal interest, or ties of Kindred in the State, but not wholly ignorant of American history, can hardly look unmoved upon those walls while reading these honored names with their varied associations with the great epochs and events, not only of the single State of which this is the University, but of the glorious country of these United States, in whose early shaping the American patriots of North Carolina, had no small or insignificant part.

In the present era of our common country, when all citizens of the United States rejoice in the prosperity and strength of the Union, and in the prospect of its perpetuity and its glorious future, one may, perhaps, be pardoned for the natural inquiry whether, during

that crucial epoch of 1861-'65, among the sons of this University there were to be found none who stood for the preservation of the Union of the States, in contradistinction to so many who represented the opposing principle of the supremacy of the individual State?

In the Historical Sketches,* written by President Kemp P. Battle, and published by the University, it is distinctly stated that this hall is to serve as a memorial to the "Confederate" Dead. No one can rightly object to the honor thus paid her heroic children by their stricken Alma Mater; but, in a University, which is, we may trust, to exist for centuries under the benign rule of a United Country, which in fact owed its revival, in part, to the former bounty of that Country in giving to the States the Land Grant Fund, should not equal honor be paid to those of her patriot sons who saw in the preservation of their common country, and of the flag they had been taught to revere, the object to which *their* devotion was due; or, can it be true that there were then to be found among the Alumni of this historic seat of Learning, only those whose patriotic affections were bounded by the narrow limits of a single State?

If this be the case, we may, at least, be permitted to hope that henceforth, the lessons of patriotism here taught may be broad enough to include the whole country above which floats that starry flag of freedom to which, in 1776, the Revolutionary Patriots of the Old North State, gave unreserved allegiance.

Institutions of Learning, like individual families, have their personal characteristics, their peculiar traditions, customs, and heritable qualities. While they are all united by a "common bond," to borrow Cicero's felicitous expression in illustrating the connection of the Arts, nevertheless, to the initiate, the graduates of each are readily distinguishable; so it is possible and natural that the sons of each should cherish their own loved "Alma Mater," with a peculiar and personal affection. Such devotion, from the evidence afforded by the record of these Inaugural Proceedings,† seems not to be lacking on the part of the Alumni of the University of North Carolina.

THE AGRICULTURAL COLLEGE MADE A DEPARTMENT OF THE STATE UNIVERSITY IN 1866.

When peace had been restored it was found that most of the endowed funds of the University had been lost; and that the United States Land Grant Fund entrusted to the State, had also vanished. The University, which belonged to the State, still had its land, buildings, apparatus, etc., and so the Legislature decided to issue a bond

*Sketches of the History of the University of North Carolina, together with a Catalogue of Officers and Students. 1789-1889. Published by the University. 1889. Pp. 242.

†University of North Carolina, Memorial Hall Inaugural Proceedings, Wednesday, June 3 1885. Raleigh. E. U. Uzzell, Steam Printer and Binder. 1885. Pp. 30.

of the amount of the U. S. Land Grant fund, and to pay the interest of this to the University, for giving such instruction as was required by the Land Grant law. This was done in 1866. The University was required in turn, to provide for two professors; who were "to teach such branches of learning as are related to Agriculture and the Mechanic Arts, in such manner as the General Assembly may precribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

This explains the placing of the State Agricultural and Mechanical College at Chapel Hill, as a Department of the University of the State. This arrangement for meeting the popular demands for instruction in Agriculture and the Mechanic Arts, seemed, for a time, mutually satisfactory to the authorities of the University and the people of the State.

In the light of the subsequent action of the Legislature in depriving the University of the income from the Land Grant Fund, and in creating a new institution at Raleigh, the capital of the State, to take the place of one of the departments of the University, the arguments of President Battle, in his report to the Board of Trustees in 1887,* are seen to have been possibly put forth to forstall anticipated attacks, if not to reply to those already made. After stating briefly the prosperous condition of the University, and reciting certain changes in, and additions to, the teaching force, which makes the Faculty, "the largest in number of any college in the south," and recording certain recent improvements, such as the erection of a new Chemical Laboratory, the President states that "special opportunities for study are offered in the branches pertaining to Agriculture and the Mechanic Arts, in Engineering, and in Normal Instruction." Post Graduate courses have also been opened.

He then sums up the history of the University since its re-opening.

The University has been in operation eleven years since its re-opening in 1875. In that time it has, in spite of extraordinary financial depression and disasters, by the enlightened liberality of the General Assembly, obtained an attendance of over 200 students, a number superior to any reached from its beginning up to 1851. It has been the means of educating over five hundred poor boys. It has furnished to the State hundreds of teachers. It was the parent of Summer Normal Schools, which have done so much for our State, and have been copied by all the Southern States. Through these Normal Schools it has given impulse to, and led to the inauguration of Graded Schools in so many of our towns. It has stopped the going out of our boys to the institutions beyond our limits, and the consequent drain of our money. It is no exaggeration to say that it has saved the State hundreds of thousands of dollars, besides preventing the loss of State pride which must result from the spectacle of an inferior public institution.

Its position has been attained without diminishing the numbers of the colleges of

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*Reports of President Kemp P. Battle and of the Committee of Visitation, Hon. W. L. Steele, Chairman to the Board of Trustees of the University of North Carolina, January 20th, 1887. Printed by order of the Board, Raleigh, N. C. Edwards, Broughton & Co., Power Printers and Binders. 1887. Pp. 38.

the State. They are all as prosperous, in several instances more so, than when its doors were closed.

STATE APPROPRIATION.

The $7,500 from the Land Scrip Fund received by the University is interest which the State agreed to pay, rather than refund the principal to the United States Treasury. Besides this, the State gives the University $20,000 annually. If we estimate what is paid by licenses, &c., this is about five or six cents on the $1,000 value of property.

IS THIS AMOUNT EXCESSIVE?

That it is not, is evident from the fact that from all the resources, the total income of the University is barely sufficient to support the institution with its present force. Every department we have should be retained, and pushed even further. Large sums are needed for new books and instruments. Until the State becomes more prosperous, receipts from tuition fees cannot be increased.

Not only the great nations like England, Germany, France, Russia, find it necessary to preserve and increase their greatness by supporting most liberally national Universities, but the States of our Union eagerly follow their example. The following list shows what they are doing for higher education.

Then follows an interesting list of 27 States, with the sums annually appropriated by them, including the income from the U. S. Land Grant Funds, to their Universities and Colleges. In this list North Carolina, with the sum total of $35,500, is about on a par in amount appropriated, with Georgia, Tennessee, West Virginia, and Kentucky; and is in excess of Maine, Connecticut, Delaware, and Rhode Island. California leads the list with the sum of $283,278.00.

The value of a State University to the people is thus suggested.

BENEFITS TO POOR YOUNG MEN.

The University is especially needed for the aspiring poor men of the State. The rich can send their sons beyond our limits. They are independent of the bounty of the State. But our poor men need an institution near at hand, among their own people. No one knows as well as I the inestimable benefits we have already conferred on such.

Several pages of biographical anecdotes of some of the Alumni, strikingly corroborate this statement. The following account of the money value to a State of leading Educational Institutions, is suggestive.

MONEY VALUE OF THE UNIVERSITY TO THE STATE.

A successful University not only supplies to a State the priceless blessgins of knowledge and trained intellect, but it is a means of saving money from going out of the State and bring money into it. Before 1861 our University brought into the State about 180 students from beyond its limits who spent at least $100,000 annually. It saved from going to other States students who would have carried out $150,000, annually, thus being worth a quarter of a million each year. The University of Virginia draws to Virginia, owing to its famous Medical and Law Schools, supported out of its $80,000 income, of which the State pays $40,000, 147 students, paying at least $90,000 annually. Princeton into New Jersey brings 358 students, paying $250,000. Yale into Connecticut 744 students, paying about $600,000. Harvard into Massachusetts 791 students, paying over $600,000. The University of

Michigan 711 students, paying at least $400,000. As our Southern land sustained such enormous losses by the great Civil War and has experienced such financial disasters recently, it is not wonderful that we have not regained our extra-State patronage in the short time since our instruction has been expanded. Let the University carry on the excellent work it is now doing long enough for the fact to be known abroad and a large measure of our former attendance will be regained.

A successful University will attract donations from those whose benevolence extends to future generations as well as the present. Since our re-organization in 1875 there have been added to the property of the State invested in our University sixty thousand dollars from private munificence.

In the opening sentences of the following paragraph it is clear that the President is aware of a rising antagonism to the University, he says:

THE LAND SCRIP FUND.

It has been charged by men who have never made any effort to learn what work the University is doing, that we are not applying the $7,500 interest received by the University according to the terms of the trust. This accusation is without foundation, as the following statement will show.

This is followed by a resumé of the provisions of the Land Grant Law of 1862. Quoting the list of the studies required by the Act, he says:

This is the only description of the college to be found. It is not said there shall be an Agricultural College, or a Mechanical College, or an Agricultural and Mechanical College, but the college to be provided by the State must be of the nature set down in the foregoing words.

What is the meaning of those words? They are easy to be understood. The interest is to be used not for farm experiments for the benefit of the public, not for building barns and silos, not for erecting workshops or purchase of stock, but for *teaching*.

What branches are to be taught?

1. The Classics, i. e., Latin and Greek, must be provided for.
2. Scientific studies generally.
3. Military tactics.
4. Specially must be taught the branches of learning relating to Agriculture.
5. Specially likewise the branches of learning relating to the Mechanic Arts.

And these two latter classes shall be the "leading object" of the instruction. But note that it is not enjoined to teach Agriculture, i. e., ploughing and hoeing, etc., nor the Mechanical Arts, i. e., planing, sawing, etc., but the branches of learning relating thereto, the scientific principles leading to the trades, not the trades themselves. It would require all the public lands, and more too, to have attached to these colleges, lands, shops, machinery, stock, etc., necessary to teach practically all the trades of the United States.

The object expressed in the Act is in harmony with this description. The object is to "promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. That is, the education is for *all* the industrial classes, not only the farmer, but for the architect, engineer, printer, carpenter, blacksmith, wheelwright, foundryman, miner, and the hundreds of others who labor with head and hands. They are to be educated *liberally* as well as practically, i. e., they are to have, not a one-sided, technical training, but a rounded culture. They are to be like lawyers, doctors, preachers, endowed with the graces of a general literary training, as well as with the sciences specially relating to their trade.

It is clear, then, that such an organization of the school as is for the benefit of

farmers only is robbery of all those engaged in the mechanic arts. Any organization which provides only for carpenters, blacksmiths, miners, etc., robs the farmers.

The instruction, then, is necessarily mainly theoretical, because it is impossible to give men in one institution practical skill in all the trades and professions of life. The only just, fair plan is, as the Act expressly says, to teach the branches of learning relating to all the pursuits of life, and then let each student in farm or workshop, or in some great costly school where farms and workshops are provided, learn the skill of hand and practical details of his trade. These great polytechnic schools being obliged to carry on practically the industries, must of necessity cost any sum from half a million to many millions, and cannot be supported except in populous and wealthy manufacturing communities.

SENATOR MORRILL, AND COMMISSIONER EATON, CHARACTERIZE THE NEW COLLEGES.

The Act of 1862 was drawn by Justin S. Morrill of Vermont, whose venerable form may be still seen in the United States Senate. In advocating its passage he describes the college as one "where all the needful sciences for the practical avocations of life shall include the higher graces of classical studies." In 1880 he thoroughly approves the following words of the Hon. Mr. Eaton, Commissioner of Education: "The task imposed upon the Colleges of Agriculture and the Mechanic Arts, founded on the Congressional grant of 1862, is rarely understood. Having nothing in their establishment antagonistic to classical culture, designed at discretion to comprehend all learning when established independently, or to harmonize with all other culture when associated as a department with institutions previously established, they are intended, undoubtedly, to furnish instruction in the direction of science, technics and industry in this country." Senator Morrill, after approving the foregoing language by the Commissioner of Education, adds the following: "They were, let me add, undoubtedly intended to be broad enough to "comprehend all learning" and to educate all classes, but their leading object was to include the branches relating to agriculture and other industrial arts, and to offer better instructions to those aiming at eminence in such busy and varied walks."

This construction harmonizes with the letter of the Act, and there is nothing in that Act which can be tortured into a contrary meaning.

TWENTY-FOUR STATES MAKE THE NEW COLLEGE A PART OF THE UNIVERSITY.

Acting on this construction, a large majority of the States, soon after the passage of this Act, when the arguments of its friends were fresh proceeded to organize these colleges as departments of existing universities or colleges. Vermont, Senator Morrill's own State, gave her scrip to the University of Vermont, New Hampshire to Dartmouth College, Rhode Island to Brown University, Connecticut to Yale College (now Yale University), New York to Cornell University, Indiana to Purdue University, New Jersey to Rutger's College, Illinois, California, Delaware, Minnesota, Missouri, Nebraska, Nevada, Ohio, Wisconsin to their universities.

The States thus using the Land Grant Fund are at this day twenty-four in number.

Can there be any doubt that the Legislatures of all these States could not have been mistaken in their understanding of the Act of 1862? Can the General Assembly of North Carolina justly be reproached for following their example:

REASONS WHY FOURTEEN STATES ESTABLISH SEPARATE COLLEGES.

A minority of the States fourteen in number, established separate institutions but either the States, or counties, towns, or individuals, gave large sums as a condition precedent to such establishment. For example:

Alabama gave	$75,000
Arkansas	170,000

Colorado	$55,000
Illinois	450,000
Iowa	500,000
Kansas	125,000
Kentucky	110,000
Florida	Not known
Maine	145,000
Maryland	100,000
Massachusetts	656,000
Michigan	340,000
Pennsylvania	532,000
Texas	212,000
Virginia	100,000
Mississippi	205,000
Indiana	340,000

In all of these institutions tuition is practically free, and the students are generally, if not in all instances, paid for their labor.

The statement of the original grant of the Land Grant Fund to the University, as already summarized in this account, is then given, with an account of the efforts that were made to acquaint the people of the State with the way in which these provisions by the law had been more than complied with, as follows:

Shortly after my election in June, 1876, the Executive Committee requested me to visit some of the leading institutions to whom the land scrip had been granted and report on the subject. I accordingly investigated in person the workings of various universities and colleges, north of us, having full conference with their chief officers. The Faculty received my report and likewise studied the catalogues of the chief institutions of this character in the United States. The result of our deliberations was a programme submitted to the Trustees and approved by them in which the utmost care was taken to carry out our obligations under the act.

This programme I explained in addresses made at various Agricultural fairs and during court week in many counties—eighteen counties in all. Moreover, when the State Grange requested of me an explanation as to our plans I replied in a letter which was published in the newspapers, giving the same programme. I sent copies to the members of the General Assembly. I afterwards addressed the General Assembly, carefully and at length unfolding our construction of the act, and our intention in regard to the same. During all this time I never heard a single objection, official or otherwise, to this construction, and we rightfully concluded that it met the approval of the public and of the General Assembly.

The General Assembly has the right under the Act of 1862, to prescribe the mode in which the instruction shall be given. If action shall be taken to this end the authorities of the University will yield a ready obedience.

An inspection of the work of the University in the branches relating to Agriculture and a comparison with that of other institutions like the Agricultural and Mechanical colleges of Mississippi, of Michigan, and of Kansas, shows that we are doing as much instruction in the Agricultural branches as the best, more than some. This will appear from the following table showing the number of hours devoted to each study in the colleges of Kansas, Michigan and Mississippi for each session. I select these institutions as they are considered by many as the most successful of similar institutions.

A list showing the comparative time given to these studies in these colleges is given, and a summary of the subjects relating to Agricul-

ture and Mechanics taught in the University; showing that fuller attention was given them at Chapel Hill, than in the other colleges. The President concludes his plea thus:

Our University has all the land and buildings necessary—the property of the State—and all the professors needed to give the requisite theoretical instruction. A small additional appropriation for erection of a barn, purchase of cattle, implements, etc., and putting the land in order, and for the salary of a practical farmer to take charge of the farm, would enable the University to give the needed practical instruction.

The agricultural students of the University have the inestimable advantage of being educated side by side with those in other pursuits, of having a broad, liberal culture equal to that of men of other professions. Mere narrow technical training is not best for them. Let them, as the Act of 1862 contemplates, study the principles of their profession. It would be useful, and it is designed as soon as the money can be spared, to have the students experiment on plots to be laid out on part of the University land, carefully and scientifically applying fertilizers and recording the results. If the bill now pending in the House of Representatives of the United States, which has passed the Senate, called the Hatch bill, shall become a law, we will have $15,000 a year for conducting this and other similar work on a large scale, and the students will be greatly benefitted by observing and assisting in the same.

A "special announcement," made by the Governor of the State, in his capacity as chairman of the Board of Trustees of the University, under date of June 18th, 1888, stated that the purpose thus anticipated had been consummated. The act, establishing a separate college, had become law; and the University deprived of the Land Grant income. Certain studies have been, therefore, relegated from the University to the new College. The University, however, is to remain fully equipped; with a Faculty of Fifteen Professors and Assistants. The catalogue of 1891–'92, shows a total of 248 students, of whom 168 are undergraduates, 18 "optional."—The Faculty numbers 20 Professors and Assistants. George Taylor Winston, LL.D., is President, and Professor of Political and Social Science.— The account of the new College of Agriculture follows:

The North Carolina College of Agriculture and the Mechanic Arts, at Raleigh.

In 1885, the Legislature provided for the establishment and support of a "Industrial School." On March 7th 1887, The Legislature, by an act supplemented to the one of 1885, changed the name of this Institution to that of "The North Carolina College of Agriculture and the Mechanic Arts," to be located on lands given "by R. Stanhope Pullen, of Raleigh, Wake County, lying west of and near the city of Raleigh." The leading educational objects of the college are defined in the law almost substantially in the terms of the U. S. Land Grant Law of 1862, and the management is placed in a Board of Trustees; which shall be composed of the members of the State Board of Agriculture, and five additional members; "to be appointed

by the Governor, by and with the consent of the Senate." Provided, further, "that the Board of Trustees shall be composed half of each political party."

The Fund of $125,000.00 derived from the U. S. Land Grant, is to be transferred from the University of North Carolina, to this new Institution, on the 30th of June, 1888, "or as soon thereafter, as the college is ready to receive it." All funds and other property in the hands of the Board of Education for the establishment of the Industrial School aforesaid, are to be turned over to this newly established college. The State having accepted the conditions of the so called "Hatch Act" passed by the Congress for the establishment of Agricultural Experiment Stations, the Legislature, by the law establishing this college, provides that the station shall be in its charge; and gives the college the use of a tract of three hundred acres, known as The Camp Mangum tract, near the State Fair Grounds, which is given to the college for its use, or that of the Experiment Station connected therewith.

The first annual catalogue* is a well printed pamphlet illustrated with a frontispiece of the college building, and with four full page wood cuts showing the students at work in the field, in the Botanical Laboratory, the Carpenter shop, and the Mechanical Drawing room. It contains, also, copies of those Acts of the State Legislature, and of the U. S. Congress, which relate to the college.

The situation and the buildings are thus described:

LOCATION.

The College site and farm, in all comprising a tract of about sixty-two acres, were donated by Mr. R. S. Pullen, of Raleigh, to the State of North Carolina for the purposes of industrial education. The gift is a noble one, and the name of the donor will be linked with the history of the College.

Situate on a commanding eminence, on the Hillsboro road, one of the principal highways into Raleigh, at a distance of three-fourths of a mile from its corporate limits, the site is, in all respects, a suitable one. The ground slopes from the building in every direction, giving almost perfect drainage, as well as handsome views of the College buildings from every direction.

The water is exceptionally good and the supply abundant.

A healthy location is one of the absolutely essential prerequisites for such an institution, and the Trustees feel assured that this is secured in the site given by Mr. Pullen.

Indeed it is a matter of history that Raleigh, N. C., and Aiken, S. C., were chosen by a commission of eminent medical experts during the late war as perhaps the most suitable places for sanitariums in the South.

The farm has been carefully cultivated for about three years, and the land is being brought up mainly by judicious vegetable manuring. More land would be desirable, but cannot at present be purchased, owing to the pressing need of more buildings.

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*First annual catalogue of the North Carolina College of Agriculture and Mechanic Arts, Raleigh, N. C. June, 1890. Fall term begins on September 4, 1890. Raleigh: Edwards & Broughton, Printers and Binders. 1890. Pp. 54.

BUILDINGS.

The present building is of North Carolina brick, made and donated by the State Penitentiary by direction of the Legislature of 1887. The granite used is from the Rolesville quarry, in Wake county, and the Crown-stone from Wadesboro, Anson county.

The building is 170 by 60 feet, part one story and basement, and part three stories and basement.

Every precaution has been taken for good sanitary arrangement. The class-rooms and dormitories are large and well lighted, and the remaining rooms, such as dining-room, chapel, reading rooms, &c., are well arranged.

A carefully planned brick workshop, two stories high, is now in process of erection, and will be ready for use by September 1st, 1890. This building will contain a machine-shop, forge-shop, wood working-shop, carpenter-shop, class-room, office and wash-room, and will be equipped for thorough work in every particular.

It is intended to erect as rapidly as means will permit, barns, silos, stables and the like, which shall be models of their kind. Meanwhile, for all purposes of instruction, students will have the use of the large buildings, for such purposes, already erected on the Experiment Station Farm, near by the Agricultural and Mechanical College.

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Provision is made in the law for the admission of 120, free State pupils, to be taken from the several counties in their due proportion.

Every student in college is, by law, "required to take a course of Manual training or labor."

The estimated expenses for the scholastic year of ten months are, for the state county students, $100.00, for the other students, $130.00. Applicants for admission must be at least 14 years of age, and able to pass an examination in the elementary studies of the common schools including "Arithmetic through fractions."

The regular courses of study are for four years, and the Degrees to be conferred are, in the Agricultural course, Bachelor of Science in Agriculture, (B. S. Agr.) and in the Mechanical course, Bachelor of Engineering, (B. E.).

The radical step thus taken by the Legislature, in the removal of the State Agricultural College from the State University of which it had been a part, and of which it seemed fitting that it, and the Experiment Station, should be departments, to another place, and the creating of a separate institution; gives interest to the following account, given in the first catalogue, of the origin of this new State institution; although this statement fails to show light upon the reasons for such action by the Legislature.

In the recent similar instance of the removal of the Agricultural College and Experiment Station, from Dartmouth College, Hanover, New Hampshire, to another town in the State, and the creation of a separate independent institution; the adequate reason was found in the conditions accompanying an important bequest.

In the present case there is, also, a valuable gift to the new college by a private citizen; but the original movement, which has resulted

in the establishment of this college at Raleigh, seems to have preceded the offer of this gift, and to have had its origin in the general movement throughout the country for Industrial Training, to a recital of which, the two previous volumes of this Report have been given. The subsequent action of the Legislature, seems to have been in obedience to the will of the farmers of the State, who demanded an agricultural college, pure and simple.

It is because of this radical change in the policy of the State, in thus removing the College of Agriculture from the University, that the statements given in this first catalogue are here quoted at such length.

A Short History of the Movement which Led to the Opening of the New College at Raleigh.

ITS ORIGIN.

The Watauga Club, of Raleigh, in January, 1885, after having given the subject considerable thought, memorialized the Legislature as follows, viz.:

'1st. To establish an industrial school in North Carolina, a training place in the wealth-producing arts and sciences.

"2d. To be located at Raleigh in connection with the State Agricultural Department.

"3d. To erect a suitable building and provide proper equipment.

"4th. That the instruction be in wood work, mining, metallurgy and practical agriculture.

"5th. That necessary shops and laboratories be erected adjoining the buildings of the Agricultural Department, and that an experimental farm in the vicinity of Raleigh be equipped.

"6th. That an industrial school is of prime importance and greatly in demand.

The committee on behalf of the Club also furnished such information as they had been able to secure regarding the scope and utility of such an institution.

Several bills were introduced in that Legislature, the one drawn by Hon. A. Leazar becoming a law on March 7th, 1885, by a vote of 51 to 11 in the House and 23 to 9 in the Senate.

The act provides, among other features, as follows:

"1st. That the Board of Agriculture should seek proposals of donations from the cities and towns of North Carolina, and wheu an adequate donation should be made by any city or town, there the school should be located, giving the place the preference which offered the greatest inducements.

"2d. That the school should be under joint control of the Board of Agriculture and directors from such town or city.

"3d. That the instruction should be in wood work, mining, metallurgy, practical agriculture, and such other branches of industrial education as may be deemed expedient.

"4th. That the Board of Agriculture should be authorized to apply annually $5,000 of the surplus funds of their department to the establishment and maintenance of said school."

After successive advertisement and many meetings, in which the subject was fully discussed, the Board of Agriculture accepted an offer made by the city of Raleigh, and appropriated the sum of $5,000 for that year, 1886, pursuant to the terms of the act.

Before this result was attained, the earnest advocates of the measure met in mass meetings on several occasions, at which committees were appointed to prepare full

information and statistics. Prominent citizens of the State from various sections manifested a lively interest in the scheme, and matters were assuming a definite shape for the commencement of the school, as shown by the payment of the amount subscribed by the city of Raleigh, the purchase of a site, &c., when certain events gave a different and broader scope to work designed to be accomplished.

Two large meetings of the farmers of North Carolina were held in Raleigh, respectively on the 18th and 26th of January, 1887. The first of these meetings, among other things, resolved that the farmers ought to have an agricultural college; and further, that the interest on the land-scrip fund should be given for a part of its support. The second meeting, with representatives from forty counties, reiterated the resolution referred to as passed by the convention of January 18th, and also considered favorably a proposal of the city of Raleigh to combine the industrial school with the desired agricultural college, offering the funds already in hand, with whatever the Legislature might provide for such an institution.

After an exciting discussion, a bill for such Agricultural and Mechanical College became a law in the Legislature of 1887 by a vote of 68 to 19 in the House of Representatives and 29 to 13 in the Senate,

Thus the scheme for the North Carolina College of Agriculture and Mechanic Arts was inaugurated, and the State took a most important and progressive step in behalf of agricultural and mechanical development.

Object and Aim of the College.

The mission of the North Cárolina College of Agriculture and Mechanic Arts can be gathered from a perusal of the sections or synopsis of the State law and the Acts of Congress quoted in this pamphlet. But it will not be amiss to give here a brief statement of what it is designed to accomplish.

Its general purpose is to teach the principles and application of the sciences, illustrating sound theory by daily practice, as to make out of its students useful and successful men, instead of mere intelligent drones.

"One of the special objects of the college is to foster a higher appreciation of the value and dignity of intelligent labor and the worth and respectability of laboring men. A boy who sees nothing in manual labor but mere brute force despises both the labor and the laborer. With the acquisition of skill in himself, comes the ability and willingness to recognize skill in his fellows. When once he appreciates skill in handicraft, he regards the workman with sympathy and respect."

The Jews in scriptural times taught each boy a trade in addition to such mental training as they thought advisable. It was a wise provision.

Some of the very best thinkers of our own time in this and other countries have acknowledged the advantages of intelligent manual training of boys and young men in well equipped schools, and institutions of this kind are now being recognized as among the practical necessities of every commonwealth.

In all branches of industry the competition of the world is bringing about a closer margin of profits, and a demand is made upon men of every calling to study the very best methods and closer economy in first production. The whole trend of such institutions as we are now commencing is calculated to work out such economic results.

In an agricultural and mechanical college the student is taught to know that work is honorable, and manual labor becomes a pleasant task when performed under the encouraging eye of teachers whom the students recognize as men of ability. It is diversified by a proper development of the thinking and reasoning powers, and the tasks *assigned* are not so long as to prove irksome.

There is no conflict between the practical education which will be given by the Agricultural and Mechanical College, and the established colleges and the University of the State. Taking our college as one department of learning and the above

named institutions as another, their spheres are widely different, and they should be of practical benefit each to the other and both to the commonwealth.

THE VAST MATERIAL RESOURCES OF THE STATE AS YET UNDEVELOPED.

North Carolina is blessed by Providence with the underlying elements of prosperity in every direction; in all of the principal crops grown in the entire country; in the capabilities of so many sections for successful cattle raising and the production of dairy products; in its trucking interests, fruit and small fruits; in its ores and minerals; its lumber and hard woods, and in its abundant facilities for manufacturing interests of various kinds.

Brains, *skill* and WORK are needed to develop these interests, and the College proposes to do its full part in the education of the youth of the State as far as it can reach them in these all-important factors.

To make agriculture profitable is one of the great problems of the age. With its collateral pursuits it not only has been, but always will be, the most important industrial calling of mankind.

As North Carolina is essentially an agricultural State, the Legislature has acted wisely in its conclusion to aid the interests of so large a class of its citizens by the creation of an agricultural and mechanical college, in which the very best methods and results can be studied and worked out practically as well as theoretically.

Full courses of everything relating to the economy of the farm, including, of course, the utilization of waste, will be thoroughly studied.

Then, too, the State therein lends a helping hand to such of its youth as may desire to engage in mechanical callings of all kinds.

The College is intended, not to produce theorists, but practical young men, who will become intelligent farmers, horticulturists, cattle and stock raisers, dairymen—men who will be interested in their work, and who will make their work profitable.

The State also has need of good mechanics, carpenters, architects, draughtsmen, contractors and manufacturers, and the College will help to make them.

In conclusion, while the College will give practical instruction to as many of our youth as it can accommodate, it is made the duty, as it will be the pleasure, of the members of the Faculty of the College to take an active part in farmers' institutes, which are accomplishing so much of good in many States of the Union, and which have happily been inaugurated by the Board of Agriculture and by the farmers themselves in our own State.

The professors will be at the service of the farmers of the State whenever they can impart such special information as may be sought at their hands. They will be glad to furnish the best methods of building and filling silos, of planning barns, stables, &c. They will also be expected to investigate and furnish thoroughly approved formulas for remedies in diseases of cattle, for destruction of insects, pests, formulas for composting, &c., &c.

COURSES OF INSTRUCTION.

THE GENERAL COURSE IN AGRICULTURE.

All students will pursue the same studies throughout the Freshman year, and the Agricultural Course will not assume its separate and distinctive form until the Sophomore year.

In the Freshman year, therefore, students, looking to the specific course in Agriculture, will, in addition to their elementary work in this line, acquire dexterity in the use of wood working tools and in mechanical drawing.

In the Sophomore year a partial separation will take place; agricultural students will give up the shop and drawing, and will proceed with the studies leading to the degree of Bachelor of Science in Agriculture.

This course includes the departments of General Agriculture, Horticulture, Arboriculture and Botany, Chemistry, History, English and Book-keeping.

MANUAL LABOR IN THE AGRICULTURAL COURSE.

While all students in this course are required to perform such manual labor in the hours for practice as in the opinion of the professors is necessary and instructive. they are not required to waste time in matters of mere drudgery, of which the majority of them have already learned enough before coming to us. We endeavor to keep in view the fact that our course is not intended as a training school for farm laborers, but for the development of brain power in Agriculture and Horticulture, and the training of the administrative ability of students in directing the great army of uneducated muscle which constitutes our farm hands. While taught that no labor is beneath the dignity of a thorough farmer when necessary, the chief effort will be to form habits of close observation and economical administration, and to inculcate broad ideas as to the possibilities of American agriculture, and thus send them out as *leaders in improvements*, instead of mere followers in ruts of other men's making.

The illustrative facilities and means for practical demonstration of the College have been greatly increased by the uniting with it the Hatch Agricultural Experiment Station, supported and maintained by the United States Government. The investigations constantly in progress at the Station not only serve the purpose of placing the student in an atmosphere of original investigation, but also serve the purpose of developing his own powers of observation and quickening his perceptions. The students will be furnished in the Senior year special facilities for pursuing original work in preparing graduating Theses—subjects for which, may be selected from original work in either Agriculture, Horticulture, Botany or Agricultural Chemistry.

THE GENERAL COURSE IN MECHANICS.

As every American is a probable land-owner at some period of his life, it is thought best that, during the Freshman year, students looking to a degree in the Mechanical Course shall take the same studies as the students of Agriculture, thereby acquiring such knowledge of the general principles of agriculture, of the composition of soils, of plant life and botany as must be of use to every intelligent citizen.

But in the Sophomore year the courses divide. Those who aspire to a diploma in Mechanics give up all work pertaining especially to agriculture, and begin the special work of the Mechanical Course leading up to the degree of Bachelor of Engineering.

This course includes the department of Mechanics, the department of Mathematics, the department of Chemistry, the department of History and the department of English and Book-keeping.

The graduatiug Thesis shall have for its subject some part of the work in Practical Mechanics, or Mathematics, to be approved by the Professor of Mathematics and Mechanics.

DEPARTMENTS OF INSTRUCTION.—DEPARTMENT OF AGRICULTURE.

PROFESSOR CHAMBERLAIN, ASSISTANT PROFESSOR EMERY.

The aim of this department is to make its pupils practical farmers as well as thorough students. In order to accomplish this end, practice and theory must go hand in hand. Science is the foundation on which improved agriculture is based.

In the class-room we must study the Science of Chemistry, Physics, Botany, Zoology, Entomology, Physiology, etc. In the field we must study the laws of Nature, learn to observe and become familiar with the little details incident to agricultural pursuits, and apply our knowledge in agricultural practice.

All the students in this course will be required to work in the farm work-shops, in the barns and in the fields under the direct supervision of the Professor of Agriculture.

The field and shop-work supplements the lectures and recitations in such a way that the application and value of the principles taught may be thoroughly understood and remembered by the students, as much time will be given to practical work as circumstances will permit.

* * * * * * *

In the course in Agriculture; Drawing and Shopwork are required through Freshman year. In the Mechanical course they are required through the entire course of four years.

Then follow, in detail, the courses in the "Department of Horticulture," under Professor Massey; and in "Pure and Agricultural Chemistry," under Professor Withers. Then comes the schedule of the two departments with which this Report is concerned, as follows:

Department of Practical Mechanics and Mathematics.

Professor Kinealy, Assistant Professor Weatherly.

In this department the aim is to combine the theoretical with the practical in such a manner as to fit the student to do the work of an engineer and designer, of a builder, or of a mechanic, according to his ability and proficiency in the course. From the beginning of the Sophomore year until the end of the course, the time of the student is divided almost equally between intellectual or class-room work and practical work. By class-room work is meant work in those subjects of general education given to the student in all the departments, and also the theoretical discussion and investigation of those subjects that pertain particularly to matters of mechanics and engineering. In the class-room work of this department it will be necessary to use text-books to a great extent, but they will always be supplemented by explanations and lectures.

The course, as laid out, is intended to give to those who contemplate it such a general and broad knowledge of the subject of mechanics and engineering, and such skill in the use of tools and instruments, and in the management of machinery as will enable a graduate to be prepared to enter upon and make a specialty of any line of work pertaining to mechanics or engineering that he may choose. No specialty, as yet, is made either of mechanical engineering, civil engineering or architecture; but those fundamental principles which underlie, and form the basis of all, are taught to the student.

In addition to his theoretical training, the student is given a most thorough and careful practical training in the use and care of tools and machinery. He is made a good workman in both iron and wood. His greater or less degree of skill, will, of course, depend largely upon his natural ability.

The class-room work in this department will be as follows:

SOPHOMORE YEAR.

Machinery and Mill-work.—This study has two hours per week devoted to it during the entire year. It includes the study of the different methods of transmitting motion and force from one machine, or part of a machine, to another by means of gear-wheels, belts and pulleys and shafting. The students will be taught how to proportion gear wheels and pulleys, in order to obtain certain velocity ratios, and to "lay out" and put up a line of shafting.

As far as possible, this subject will be made clear and plain by explanations in the shop buildings and by visits to neighboring manufacturing establishments.

Building and Building Materials.—Two hours per week for one-third of a year. This is lectures upon buildings and structures and the materials which enter into them. The students are taught the names of the different parts, and the correct methods of making and fixing each in its relations to the others. They are also taught to make estimates and bills of materials.

Physics.—Two hours per week for two-thirds of a year, following the subject of Building and Building Materials. The time is devoted principally to the study of heat and its effects upon materials This subject is a prelude to the study of Steam and Steam Machinery, which comes during the next year.

JUNIOR YEAR.

Steam and Steam Machinery.—Two hours per week during the entire year. This is a study of engines and boilers, and steam-plants in general. A text-book will be used.

Graphic Statics.—Two hours per week for one-third of a year. The student learns to determine the stresses in framed structures, bridge and roof-trusses, by the graphic methods. This study is a prelude to the subject of Bridges and Roofs in the next year, and is taught entirely by lectures.

Surveying.—Two hours per week for two-thirds of a year. During the Winter the students will confine their attention to a theoretical study of the principles of surveying, and in the Spring they will be taken into the field and made to make a practical application of their theoretical knowledge by surveying and laying off land. They will in this way become thoroughly familiar with the theory and practical use of surveying instruments.

Each student will be required to plot and work up his field-notes.

SENIOR YEAR.

Applied Mechanics.—Three hours per week during the entire year. This is the application of the mathematical knowledge of the student to the investigation of the effect of forces upon bodies and structures, and the resistance of engineering materials to stresses of various kinds.

Bridges and Roofs.—Two hours per week during the entire year. The students are here taught the analytical methods of determining the stress of the various members of a roof or bridge-truss when subjected to varying loads. They are also taught the methods of proportioning the members of a truss so as to resist the stresses with the least expenditure of material.

Lectures upon Roads, Sewerage, Water, &c.—Two hours per week during the entire year. These lectures are intended to cover such subjects of general engineering as require a knowledge only of those principles with which the student has already become familiar.

Department of Practical Mechanics.

During this last year, 1889–'90, the practical work in the Department of Practical Mechanics and Mathematics has consisted simply of a course in carpentry and a course in drawing. Both of these courses have been taken by all of the students.

The carpentry shop is equipped with thirty carpenter-benches and all the necessary tools for each bench.

Each bench is provided with a cross-cut saw, rip-saw, back-saw, try-square, T-bevel, steel-square, nail hammer, mallet, marking gauge, screw-driver, oil-stone, zinc oiler, and a brush for dusting off the bench.

These tools stay on the bench, and are used by any student who works at the bench. Only one student works at a bench at any one time.

In addition to the tools named above, each student, upon entering, has issued to

him, a jack-plane, $\frac{3}{4}$-inch chisel, $\frac{1}{2}$-inch chisel, $\frac{1}{4}$-inch chisel a slip-stone and a two-foot rule. These tools are used only by the student to whom they are issued, and he is held responsible for them. He is required to keep them sharp and in good order, and upon leaving college to return them to either the professor or his assistant.

All the exercises in the shop are designed simply for the instruction of the students. Nothing is made for sale. It is the training of the student only, for which the exercises are designed.

Students Must Make All Work from Their Own Working Drawings.

All work is done from drawings. A drawing of the exercise to be made is hung up in the shop, and each student makes a copy of it, putting on it all the necessary dimensions and notes.

This copy is then submitted to the instructor, who makes such corrections and alterations as are necessary and then returns it to the student, who proceeds to make the exercise from this drawing without having seen the object that the drawing represents.

In the beginning of the course, the instructor is obliged to give a great deal of explanation to the class as to the meaning of the various conventional signs on the drawings, and, also, to show each student how to "lay out" his work from the drawing. As the students acquire facility in reading the working drawings and skill in "laying out" work, and in handling tools, the exercises are made more difficult.

When an exercise is given to the class, the instructor explains where and how, the joint or work illustrated by that particular exercise is used in practical construction.

All the students of one class are at work upon the same exercise at the same time. And those who, by reason of their natural aptness and ability, finish their exercise before the others, are given pieces of work to do for the college, or are given an extra exercise to keep them busy.

It must be remembered that all work done in the shop, whether as an exercise or in the construction of an article for the college, is done from drawings.

Building for Wood and Iron Work Shops.

The Board of Trustees have already made arrangements for the erection and partial equipment of a large shop building. The building will be a two-story building, and will contain on the first floor, a Machine Shop, 30 x 40 feet; a Forge Shop, 30 x 40 feet; an Office and Class-room, 23 x 24 feet, and a Wash-room, 10 x 23 feet. On the second floor will be a Wood Shop, 30 x 40 feet; a Carpenter Shop, 30 x 40 feet, and a Drawing-room, 23 x 35 feet.

This building will be finished and the Forge Shop will be equipped during the summer of 1890 in order to be prepared to continue the class in shop work. The Forge Shop will be fitted up with a number of forges. Each forge will be equipped with a water-tank, shovel and poker. For each forge there will be provided the following tools: an anvil, hammer, steel square and hardy. In addition to these, there will be sledges, swedges, fullers, flatters, and hot chisels, for general use in the shop.

The work in the Forge Shop will consist of a number of graded exercises by which the students will be taught to work in iron and steel. The students will begin by forging simple shapes out of lead, in order that they may acquire skill in the use of the various tools, and may learn to work fast. They will then be taught how to build and tend the fire, and to heat iron. When they can do this, they will then forge simple shapes out of hot iron. They will learn to "bend," to "draw," to make "scarfs," and to weld round or rectangular pieces of iron.

After they have acquired some skill in working with iron, they will then be taught to work with steel and to temper it, and be given a short course in tool-making.

In 1891 it is proposed to equip a complete wood-working shop, with wood-turning lathes, a band-saw, mortising machine and other tools. In this shop the students of the Junior class will be given a complete course in wood turning and pattern making, and a limited course in moulding.

In 1892 the Machine Shop will be fully equipped with lathes for iron, shaper, planer, and other machines necessary for a complete course in machine-shop work.

After the Freshman year each student in the mechanical course will be expected to work 7½ hours per week in one of the shops.

DRAWING.

During the Freshman year all the students in the college take a course in drawing. The drawing of this year consists of a little free-hand sketching, a course in lettering, and the elements of mechanical drawing.

After the Freshman year each student taking the mechanical course will have drawing one hour a day, or what will be equivalent to that time. Each student will be taught to make complete and full plans, elevations, sections and details of work and machinery already built and set up. The students will be taught the conventional signs and symbols used in drawing, and all drawings will be marked, lettered and finished, as if they were to be used in a regular manufacturing establishment. Students will be required to make tracings of some of their drawings, and from their tracings they will take blue prints. After the student has entered the Senior class, he will then be required to make drawings of one or more original designs.

As far as possible the work in the drawing-room and in the shops are made to supplement one another. In the shop the students make objects from drawings, and in the drawing-room they for a long time confine their attention to making drawings of objects that already exist.

In this way they will be taught not only to work from and understand drawings, but also to express clearly their own ideas in the conventional language of the draughtsman.

The Departments of "English," and "Book-keeping," under Professor Hill; and History, under President Holladay, follow.

The students enrolled the first year number 72. The Faculty of the College number 8, Professors and Assistants. The officers of the Experimental Station, number 10. The President of the College is Alexander Q. Holladay.—

The Ohio State University, Formerly Known As The Ohio Agricultural and Mechanical College, Columbus, Ohio.

PRELIMINARY WORDS.

During the thirty years that have passed since the opening of this college under President Orton, there have been marked changes in the attitude of the public towards such institutions, as well as in the development of Education in Science itself:—a change exemplified by the contrast between the narrowest conception of an Agricultural College, by which it was practically limited to the educational work of an English High School combined with the manual labor

required from all the pupils in the every day work of the college farm, and the most advanced type of a Polytechnic Institute; with a large staff of learned science teachers, and fully equipped with the many Laboratories, Machines, Libraries, and Museums, requisite to meet the exigent demands of the advanced Scientific education of to-day.

The history of the development of the institution now known as the Ohio State University, as recorded in the reports of Supervising Trustees on the part of the State, and in those of its own officers, illustrates in an effective way many phases of this many sided development of Modern Education; touching as it does in its beginning, the public school drawing initiated by the late Walter Smith, in Boston, and including in its work of to-day, the most recent developments of Manual Training as well as the latest technical developments of Scientific Engineering in all its departments. Ranging thus, in its experience, from the industrial drawing of the public schools to the latest mysteries and discoveries of Electrical Engineering.

It has, also, run the whole gamut of financial experience, from the time when it seemed impossible to induce the State Legislature to take any care of this recipient of the National Land Grant Fund, until, at last, by the action of the Legislature in making as permanent provision for the State University as for the public schools, of which it is the crowning summit, it has been placed upon a sure foundation.

In the account of these experiences, so well set forth in the several official publications, there is so much that is of general value to all interested in similar institutions, as well as so much that is in common with the purpose of this Report, that it has been judged expedient to make exceptionally full extracts from these "Official Reports," where they touch upon these various topics; to give statistics, showing the growth of the institution; and the increasing proportion of "graduates" to students; as well as statements in detail, of the "courses" in "Drawing," and in "Mechanical Engineering," with which this volume of this Report is especially occupied.

CONCISE HISTORICAL STATEMENT.

This Institution was founded by the Legislature, by act passed March 22, 1870,—in accordance with the provisions of the United States Land Grant law of 1862,—under the name of "The Ohio Agricultural and Mechanical College."

The county of Franklin, contributed the sum of $300,000, to secure the location of the college; and a valuable farm, of over 300 acres, and situated within three miles of the State Capitol in the city of Columbus, was purchased in 1870, and suitable buildings erected. The College was opened for students in 1873.—

The Legislature, by act of May, 1st., 1878, reorganizing the Board of Trustees, directed that the designation of the institution should be changed to that of "The Ohio State University," the former designation having been thought misleading as too narrowly limiting the scope of the education afforded by the institution, which was far more comprehensive than a literal construction of its name would imply; three degrees, those of Bachelor of Arts, and Bachelor of Science, and that of Civil Engineer, being given; each requiring a four years course of study. A special course of Agriculture was also provided, of three years.—

A Department of Free-hand and Mechanical Drawing, was established on the opening of the college, which was largely attended.—

That the new development of the institution was not limited to a mere change of name is shown by the fact that the Annual Report for 1880, shows Fifteen departments of studies; and, in lieu of the regular degrees above mentioned, that the University now offers "three general degrees, viz: Bachelor of Arts (B. A.) Bachelor of Philosophy, (Ph. B.) and Bachelor of Science, (B. Sc.). It also offers four special degrees, viz: Civil Engineer, (C. E.), Mining Engineer, (M. E.) Mechanical Engineer, (Mech. Eng.), and Bachelor of Agriculture, (B. Ag.)."

A preparatory course of two years with a course of study analogous to that of the best grade of High Schools, is also afforded for students coming direct from the district schools.—

Free-hand drawing is taught in all the regular courses throughout Freshman year. In Mining Engineering "projection drawing," is taught the first term and "special drawing," the third term of Sophomore year. In Civil Engineering "Shadows and Perspective" are taught, 2nd term of Senior year. In Mechanical Engineering, "Projection Drawing," the first term of Sophomore year, and "Technical Drawing," the second and third terms of Senior year.

In view of the new departure inaugurated in 1879, in the increased prominence given to drawing of which the Report of 1880, gives the account of the experiment for the first year, that part of the Report is quoted—comprising the references to it in the Report of the Trustees to the Governor; of the President of the University to the Trustees; and of the Special Instructor in charge, to the President.

These statements are of somewhat exceptional interest as showing the far-off results of the work in the public schools begun by the late Professor Walter Smith, in Massachusetts, in 1871.

The Report of the Trustees gives evidence of an intelligent appreciation of the importance to a community of thorough and general training in the application of art to industries.

ART DEPARTMENT.

Heretofore instruction in Free-hand and Mechanical Drawing has been given. The new Art Department is projected upon a broader *utilitarian basis* and contem-

plates instruction not only in drawing and painting, but also in designing, modelling, engraving, etc. It is not designed to make it a school for the culture of *liberal* or *fine arts*, so much as for *technical* instruction in the *useful* arts; to make the *artisan* rather than the *artist;* and to impart that form of knowedge essential to skill and taste in the architect, the bridge and ship-builder, the mason, the machinist, the engraver, the cabinet-maker, the decorator and the designer of textile fabrics, and every kind of artisan in the catalogue of human industries.

Our costliest and largest importations of manufactured articles from foreign countries, and especially France, do not derive their chief value from either the quality or quantity of the raw material of which they are composed, but from the amount and character of the *tasteful* and *skilled* labor employed in their production. It is this skill that increases the value of labor so greatly, and constitutes in countries poor in soil and in natural production, a source of immense *material* wealth. Here, in Ohio, where the natural productions exist in such abundance, upon which the laborer subsists, and upon which he operates, this element of material wealth should be greatly conserved.

If, as has been wisely said, that education is the fitting of youth for the occupations of adult life, and the duties of good citizenship," and that the uniform demand for the products of *skilled* labor, in our markets, is already turning, our industries in that direction, no scheme of education can be regarded as complete, that does not embrace art culture.

Mr. Wm. A. Mason, of Cambridge, Massachusetts, a graduate of the highest standing in the Massachusetts Normal Art School, has been called by the Board to take charge of this Department as Assistant Professor. The necessary equipment is being provided as rapidly as possible.

The brief reference by the President shows that he puts a true estimate upon the worth of the training heretofore given by Professor Walter Smith, in the Normal Art School of Boston.

"Mr Thomas Mathew, who had served the college with great fidelity for six years in the capacity of Instructor in Free-hand and Mechanical Drawing, retired at the close of the last academic year. He takes with him the thorough respect and cordial good-will of the Faculty, with whom he has worked so loyally and faithfully. His place is filled by the appointment of Mr. W. A. Mason, a graduate of the Normal Art School of Boston. The statement of this fact is equivalent to saying that Mr. Mason has enjoyed the best advantages for learning the theory and practice of industrial art to be found in this country. He has made a successful beginning of his work."

The report of the teacher in charge shows that, in addition to the specific work of teaching the University students, he has imbibed from his own Teacher, the idea of the great importance to the community at large, of so training teachers that this study of industrial drawing may be every where disseminated among the public schools.

MECHANICAL AND FREE-HAND DRAWING.

OHIO STATE UNIVERSITY, *Columbus, Nov.* 1, 1880.

EDWARD ORTON, PH. D., *President:*

DEAR SIR: I have the honor to present my first report for the Department of Mechanical and Free-hand Drawing.

Having been connected with the University for so short a time, I cannot report so intelligently as I should desire concerning the state of my department. The term opened with about 40 students in my department, but the number has now increased to 55. My students are divided into two classes, one group constituting

the Free-hand Drawing class, and the other, the class in Mechanical or Projection Drawing.

In the former class there are now 42 young men and ladies pursuing courses in Industrial and Artistic Drawing—drawing from the flat, in outline, or shaded; drawing from the round in various mediums, with the intention of extending the study to working in color. In the Projection Drawing class there are now 13 young men studying and practicing the elements of mechanical drawing as a preparation for the special drawing in their respective technical courses.

This latter study is completed in one term, whereas the Free-hand Drawing class holds for the whole year.

Having stated the nature of my classes and the work which is being done, I shall be pleased to forecast what I hope will be the course to be pursued in the future in my department.

Drawing is rather an exceptional study, but although its principles are as exact and demonstrable as those of any other study, the practice of the art is limitless. With many of the sciences, arithmetic or geometry, the study is soon carried to an end, but with drawing, the earlier it is begun and the ofteuer it is practiced, the greater the mastery of the hand and the discernment of the eye. Therefore, I should hope to see drawing introduced into either the first and second, or the second year of the Preparatory Course.

The amount of time being two hours per week; and the subject taught by class-lectures of one hour each. Great advantages are obtained by class-lectures in drawing, as in any other study; an amount of enthusiasm is kept up, the attention of all members of the class is better secured, and principles of form, perspective and color are much better and vastly more easily explained once before a class, than many times individually in the studies.

This earlier commencement of the study will undoubtedly develop latent talent, leading many perhaps to continue the study, who would not otherwise have taken it later in their college courses, owing to the press of other studies.

In the Freshman year the study should be taught as it is now—two hours per week, and in the same manner—by studio practice. The principles having been learned in the previous year by the class-lectures, and the elementary part of the practice acquired, the students will now be prepared to take up the studio work proper.

The studio has been stocked with a number of excellent plaster casts for drawing from, and a hundred or more drawing-copies in outline and shaded; and I feel certain, that were the studio better filled up—with screens for the casts to hang on, good facilities for work, and proper light, it would attract many more than at present pursue the study. * * * *

As regards Projection Drawing, it would seem wise to introduce it into the first term of the Sophomore year of the Civil Engineering Course. It will give these students the elementary training for the special engineering draughting, and will synchronize the study in all the technical courses.

One other suggestion I would like to make, and that is, that a good opportunity may now be offered to persons desirous of becoming teachers of drawing, or to those who desire to pursue special courses in Art. A great amount of time can be utilized that is not now used in its fullness, due to the irregularity of the students' hours. If the students, who now come in at various hours through the day, could by any harmonious means be brought together, a great deal of time could thus be saved, and may be devoted to the special students in Art. This would be fulfilling the demand of the times for designers, and for teachers of drawing in the public schools; in other words an Art Training Department might be established. This is a suggestion to be considered with no little attention.

Very respectfully,

W. A. MASON, JR.

The catalogue showing attendance from November, 1879, to November, 1880, gives a total of 315 students, "preparatory," "special," "regular" and "graduates of 1880." Of these, 60, are undergraduates in regular courses; 24, in special courses; and 13, were graduates.

A history of this University will be found with those of the other colleges in the State, in a recent "Circular of Information", issued by the U. S. Bureau of Education.* (See pages 36–51 of "Circular.") In this pamphlet are full page illustrations of the buildings, and interiors, showing the Museum, Library, Laboratories and Work Shops; from which it appears that the various departments of the University are well housed and fully equipped. The recital of its early vicissitudes before it had fully secured recognition as one of the State institutions which were to be fostered by the State, (two others having been suffered to starve by reason of Legislative neglect in the matter of appropriations), and, also, of the conflict arising from differences of opinion as to the proper field and functions of the Land Grant Colleges, it being hotly disputed as to whether this should be an elementary school, looking only to the ordinary training "in practical agriculture and the mechanic trades," as Governor Brough, then Governor of the State, earnestly contended; or, a polytechnic institute, looking to higher technical and scientific instruction in a knowledge of all the Industries, will be found interesting and instructive.

The unmistakable tendency of the higher education in Science to direct young men away from an inclination to undertake the daily drudgery of the actual work of a laborer on the farm, or at the mechanics bench; and to stimulate, by giving a knowledge of their higher possibilities, that "divine discontent" in which all modern civilization of the masses has had its origin, being recognized; there was, for some time, danger lest the higher development of the proposed college should be rendered impossible; but, fortunately, in the charter of the college, given by the Legislature in 1870, the Trustees were empowered with full authority "to fix and regulate the course of instruction."

The Trustees were not, however, by any means in accord on this question. An agreement was finally effected by which the report of a committee of the Trustees, in relation to courses of study, was adopted in January, 1871.—This recommended the organization of ten Departments, namely: 1. "Agriculture;" 2. "Mechanic Arts;"

* Bureau of Education. Circular of Information No. 5, 1891. Contributions to American Educational History edited by Herbert B. Adams. No. 12. The History of Higher Education in Ohio by George W. Knight, Ph. D., Professor of History, Ohio State Univ., and John R. Commons, A. M., Associate Professor of Political Economy, Oberlin College. Washington, Government Printing Office. 1891. Illustrated. Pp. 258.

3. "Mathematics and Physics;" 4. "Chemistry;" 5. "Geology," "Mining and Metalurgy;" 6. "Zoology and Veterinary Science;" 7. "Botany," etc; 8. "English Language and Literature;" 9. "Modern and Ancient Languages;" 10. "Political Economy;" this was substantially the plan of Mr. Joseph Sullivant, of Columbus, a trustee, "who had labored long and earnestly to establish the projected institution on the broadest basis consistent with the terms of the congressional grant."

FINANCIAL RESOURCES OF THE COLLEGE LIMITED IN ITS EARLY DAYS.

The small outcome of the large U. S. Land Grant given to the State by the law of 1862, seems pitiful by contrast with the princely fortune secured from the similar grant to the State of New York, by Ezra Cornell. In the case of Ohio, most of whose land brought but a little over fifty cents an acre, a shortsighted policy due to impatience to realize the gift in money, led to a foolish sacrifice of values. This was likewise the case in many other States. However, in the end, the State Legislature of Ohio, came to the support of the University with liberal appropriations, and the value of the land, given to it by the county to induce the placing of the institution at Columbus, is rapidly increasing owing to the growth of the City. So that, in view of the proposed removal of the Experiment Station to Wayne County, it seems probable that eventually the University may secure a large endowment fund by selling such of its territory as is not longer needed for that station.

From 1877 to 1891, inclusive, the sum total of $356,260.00 had been appropriated from the State Treasury to the uses of the University.

During the earlier years nothing was given, it being assumed that the income from the Land Grant Fund, and the bonus given by the county of Franklin, was sufficient. The first appropriations were made in small amounts; but from 1882, they have been much larger; now that, as will be noted later, the institution is made a fixed charge on the income of the State, it is no longer to be dependent on annual appropriations.

This is, of course, a great relief to the Trustees and Faculty.

SMALL BEGINNINGS.

In 1873, the college was opened with Edward Orton, PH. D., —who had been chosen, while President of Antioch College,—as President, and Professor of Geology. A faculty of seven Professors, in addition, filling the chairs of Geology; Physics and Mechanics; General and Applied Chemistry; English and Modern Language; Agriculture; Zoology; and Ancient Languages; completed the teaching force of the new college. For awhile the course was a preparatory one, of two years, leading to a group of parallel

courses of four years each with limited elective studies. As already stated in the preliminary pages of this account, a reorganization was effected in 1879; which practically remained in force till 1886, when, with an increased corps of teachers, and a higher standard of entrance, the elective system was again introduced in the three non technical courses. The amount of work was, however, specified; and the ratio of elective to specified studies was fixed. After several changes in the organization of the Board of Trustees, it was settled that it should consist of seven members to be appointed by the Governor, and to hold office for seven years each; and so appointed as that one vacancy occurs each year.

SUCCESSION OF PRESIDENTS.

President Orton was President till 1881, when he resigned the office, retaining, however, the Professorship of Geology. Rev. Walter Q. Scott, D. D., was President till his resignation in 1883, when he was succeeded by Rev. Wm. H. Scott, LL. D., who was called from the Presidency of the Ohio University, at Athens. The number of students had grown from a total of 90, in 1874; to a total of 493, in 1890. As the charter of this college contained no provision limiting the attendance to males, girls presented themselves at the opening and were received; so that this college has always been open to the attendance of both sexes.

The latest annual report* by the Board of Trustees to the Governor of the State, gives a very favorable showing of the present prosperity of the University. From this report, and from the latest catalogue at hand, extracts are freely taken, giving the official statements of the general development of the institution, and showing the especial attention given to Drawing and Mechanical Engineering.

REPORT OF TRUSTEES.

OFFICE OF THE BOARD OF TRUSTEES OF THE OHIO STATE UNIVERSITY,
Columbus, Ohio, November 15, 1891.

HON. JAMES E. CAMPBELL, *Governor of Ohio:*

SIR: In compliance with law the Board of Trustees respectfully submits the twenty-first annual report of the Ohio State University.

A financial statement shows that the "endowment fund" as given November 15th, 1891, amounted to $544,745.97; of which the annual interest is $32,684.75.

Receipts from sources other than State or Congressional appropriation, amount to	$50,495.07
State appropriations for the year	32,300.78
Receipts from appropriation by Congressional Act of Aug. 30th, 1890,	48,000.00
From these various sources the income for the year 1891, amounts to	163,480.60

*Twenty-First Annual Report of the Board of Trustees of the Ohio State University, to the Governor of the State of Ohio, for the year 1891. Columbus, 1892. Pp. 124.

THE FACULTY.

The number of professors employed by the university is twenty; associate professors, four; assistant professors, five; assistants, fifteen. This does not include the faculty of the school of law, which is composed of the dean, secretary and a board of instruction.

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THE LIBRARY.

The number of books in the library at the close of the university year, ending June 30, 1890, was 9,345. The number at the close of the year, ending June 30, 1891, as shown by the report of the librarian, was 10,494. This number has been somewhat increased since the last mentioned date. We are not able to state the exact number of the additions, a part of them not having been catalogued, but the whole number of volumes now in the library, exclusive of pamphlets, is nearly 11,000.

Professor Derby, who has ably discharged the duties of librarian for many years, has exhibited rare judgment in making purchases, and the collection, though still meager, is well selected and well adapted to the needs of the university. Provision is made for its temporary accommodation in the new geological building now being constructed, where it is hoped it can be removed and preserved from the danger to which it is constantly exposed while in a building which is not fire-proof.

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THE AGRICULTURAL EXPERIMENT STATION.

It is learned from unofficial sources, that the Agricultural Experiment Station, which since its organization in 1882, has carried on its investigations and experiments at the university, has accepted the donation of money and lands offered by the citizens of Wayne county, authorized by an act of the general assembly, and will in a short time remove to its new location.

In one sense such removal is a loss to the university, in that it takes away the officers and staff of the station who have been co-workers with the agricultural faculty in many important lines of investigation and research. In another sense it is a gain, inasmuch as the lands the station has occupied will be more available for practical instruction in agriculture and horticulture, and will afford larger opportunity for development in these important branches. Though controlled by a separate board of trustees, the relations between the station and the university have been friendly and cordial, and it was the hope of the latter that the arrangement under which the station has carried on its work at the university so long and so successfully, might be continued.

PROGRESS OF THE UNIVERSITY.

The progress of the university during the past year has been very encouraging.

The increase of students has been larger than in any former year. The number in attendance at the present time is 31 per cent. greater than at the same date last year.

The increase in the material resources of the institution is no less gratifying. The act of congress of August 30, 1890, supplementing the original endowment of the university, was accepted by the general assembly May 4, 1891. This act provides an annual appropriation beginning with $15,000 for the year ending June 30, 1890, and increasing the amount $1,000 a year until it is $25,000, and then continuing it indefinitely.

The Board of Trustees and the President in their annual reports for a number of years past have presented the disadvantages and discouragements in having to depend for a large part of the current expenses of the university on yearly appropria-

tions by the legislature, and have urged the levy of a fraction of a mill on the grand duplicate for its support and maintenance. During the last year the alumni gave the measure its cordial and active support, and the friends of the university united in its advocacy. In your first annual message it received the great weight of your official indorsement and recommendation, and on the 20th day of March, 1891, the general assembly passed an act providing for a levy of one-twentieth of a mill on the grand duplicate of the State, to be known as the "Ohio State University fund," to be applied to "higher, agricultural and industrial education, including manual training."

This levy would yield on the last year's duplicate, making the usual allowance for delinquencies, $87,795.61. The grand duplicate for the present year is not yet completed, but we are informed by the auditor of state that it will be about the same as last year.

These two noble provisions, if wisely administered, insure the continued healthy growth and progress of the university. They place it among those of highest rank. The latter provision is regarded by the friends of higher education throughout the country as a measure of vast and far-reaching importance. While these provisions largely increase the income of the university, it is still small compared with those of other less favored states.

All, and more than the additional resources they provide, are needed for additional buildings and equipment. The buildings already contracted for will require all the increased income for the next two years to complete and equip them.

If it shall become necessary to ask further aid until these buildings are constructed, in order to avoid curtailing the existing teaching force required by the rapidly increasing attendance at the university, may we not hope that it will be forthcoming?

The future of the university rests on the cordial approval and support of the people of the state. They, and they alone, can make it the pride and glory of her public institutions.

Very respectfully, your obedient servant,

ALEXIS COPE,
Secretary.

The report of the President to the Board of Trustees is of the same date as their report to the Governor, November 15th, 1891.—

THE REPORT OF THE PRESIDENT.

To the President of the Board of Trustees:

DEAR SIR: I have the honor to submit my report as president of the university for the year ending November 15, 1891.

The year has been one of great material prosperity. The financial resources of the university have gained at one bound as much as they had reached in all its previous history. And this gain was intended to be permanent. What has hitherto had to be striven for with new effort every year has been made secure, we hope, once for all. This result has been attained through the enactment by the general assembly of an amendment to section 3951 of the revised statutes, placing the university on the grand tax duplicate of the state side by side with the common schools, and providing that one-twentieth of a mill shall be levied annually for its support. For this great consummation, honor is due to many active and zealous friends. Governor Campbell, for the cordial recommendation of the measure in his message and the cordial support of it afterwards, and Hon. N. R. Hysell, speaker of the house, who introduced and earnestly advocated its passage, are entitled to the gratitude of every friend of education. Never were alumni truer to the cause of their *alma mater*. But to name all would be impossible, and to discriminate further would be unjust.

ADDITIONAL PROFESSORS APPOINTED.

The year has witnessed a considerable increase in the body of teachers. The last catalogue contained a list of thirty-eight, four more than had been employed the preceding year. Since that time several other additions have been made.

The department of civil engineering was strengthened by the appointment of Mr. Edward A. Kemmler, of the class of 1888, as assistant; the department of mechanical engineering, by the appointment of Mr. Frank J. Combs, as assistant in forging and wood-work; and in the third term the president was relieved of a part of his work by the appointment of Mr. George P. Coler as assistant. Mr. Coler has since been elected assistant professor of philosophy.* These appointments were made during the progress of the year.

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At the meeting in June, in recognition of his long and useful service, Dr. N. S. Townshend was made professor *emeritus* of agriculture. Dr. Townshend aided in securing the passage of the Morrill law of 1862. He was one of the most active in pressing the acceptance of the provisions of that law and in urging legislation in accordance with it, upon the general assembly of the state. He was appointed a member of the first board of trustees; and finally, after taking part in the election of two or three members of the faculty, he was himself made professor of agriculture, and has now for eighteen years been a strong bond of union between the institution and the farmers of the state. His wide acquaintance, his cordial manner, his fullness of knowledge and his readiness of speech have made him a popular lecturer at the farmers' institutes, and a potent champion of the University when she needed defense.

At a meeting of the board held September first, Thomas F. Hunt, professor of agriculture in the State College of Pennsylvania, was elected to a similar position here, his term of service to begin January 6, 1892.

A series of interesting tables showing the distribution of students among the different courses of study during the years of Dr. Scott's Presidency follows :—

In 1891, out of a total of 656 students in attendance 81 are women; of these, 57 are in the collegiate and special courses, and 24 in the Preparatory. A School of Law, was opened October 1st, 1891, and fifty Law students are recorded in attendance.

The total number of students enrolled from 1874, to 1890, inclusive

*The appointment of Professor Coler, recalls the promising experimental school of the Baltimore and Ohio Railroad Company, at the Mt. Clare shops near Baltimore, so earnestly advocated by Dr. W. T. Barnard, Assistant to the President, in the admirable report made by him to President Robert Garrett, in the autumn of 1886, and of which school Professor Coler, became the Principal.

This technological school, adapted to the special training of apprentices with a view to the creation of a trained corps of railroad employees, attracted great interest. The technological schools of Europe and America had been carefully examined and the planning of the courses of this school most intelligently undertaken. It is a matter of regret that under a change in the management of the Road this experiment has been abandoned. Dr. Barnard's report, advocating the establishment of the school, is an able contribution to the literature of the new education and is well worthy the careful consideration of all who may be interested in the development of methods of technical training adapted to special industries. The investigations and experience of Professor Coler, during his connection with this undertaking, would seem peculiarly to fit him for similar educational work. I. E. C.

is 5,213. The record from 1881 to 1890, shows a steady annual increase in the proportion of "collegiate," to "preparatory" students. In 1881, there were 242 "Preparatory," to 114 "collegiate." In 1890, there were 181 "Preparatory" to 312 Collegiate.

The following list of degrees conferred during a series of years shows how few, relatively, continue till the end of the courses.

The whole number of degrees conferred in course since the founding of the University is two hundred and forty-three, of which two hundred and thirty-three were graduate, and ten were post-graduate. They are arranged by year and title in the following table:

	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Bachelor of arts	1	1	6	2	2	1	5	4	6	8	6	1	7	2
Bachelor of philosophy	....	....	....	2	....	2	2	1	1	2	6	7	5	8
Bachelor of science	5	5	1	2	5	3	2	4	2	4	4	9	2	10
Bachelor of agriculture	....	....	....	....	....	....	....	1	1	....	....	....	2	3
Civil engineer	....	....	....	....	....	1	1	1	3	3	4	1	2	1
Mechanical engineer	....	....	1	....	2	4	1	2	1	2	4	2	3	2
Engineer of mines	....	....	1	1	....	....	2	3	4	2	4	2	....	....
Graduate in pharmacy	....	....	....	....	....	....	....	....	....	3	....	2	3	6
Doctor of veterinary medicine	....	....	....	....	....	....	....	....	....	1	....	1	4	....
Master of arts	....	....	....	....	....	....	....	....	....	....	....	1	1	1
Master of science	....	....	....	1	....	....	....	....	....	....	....	1	1	2
Doctor of philosophy	....	1	....	....	....	....	....	....	....	....	....	....	....	....
Doctor of science	....	....	....	....	....	....	....	....	....	....	....	....	1	....

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The courses of study have undergone a large number of modifications, some of them of considerable magnitude, and one new course has been adopted. The latter is a course leading to the degree of batchelor of philosophy, but differing from the other course leading to that degree in offering a much larger opportunity for the study of modern languages.

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The tendency of all successful institutions of learning to grow in various directions, is illustrated by the following statements:

The development of the several departments has added strength on every side. The amount expended for equipment in some departments will indicate the advancement made within the year. In agricultural chemistry the amount expended was eight hundred dollars; in general chemistry, about fourteen hundred dollars; in zoology and entomology, nearly sixteen hundred dollars; and in physics, about twenty-five hundred dollars, with orders outstanding to the amount of two thousand dollars.

INCREASE IN NUMBER OF STUDENTS OUTSTRIPS THE FACILITIES.

The healthful growth in the attendance of students and this steady improvement in the equipment are very gratifying. The present facts show that the university is meeting the demand both for thorough instruction in special subjects and for a broad and liberal culture. But the picture has a reverse side. The wants of the institution have by no means been satisfied. Indeed, new and greater wants spring up faster than the old can be met. The massing of students in the engineering courses, especially the course in electrical engineering, has created a great pressure on the room, the resources and the teachers of some of the laboratories and of the department of drawing. The number of students in the mechanical laboratory is forty-five while there are separate working places for but thirty-six. In the laboratory of agricultural and engineering chemistry there are one hundred and

twenty-six students, while there are but fifty-four desks. In the physical laboratory there are forty-eight students, which is an increase of twelve, and the number next term will be still larger. The number preparing to enter it next year, estimated from the announced choice of courses by students now here, is eighty. In the electrical laboratory there are seven students, an increase of four; and the probable number for next year is eighteen. In the department of drawing there are two hundred and twenty students, an increase in one year of one hundred and four, or about ninety per cent. The development of the departments should keep pace with the number of students, and this will require more space, more appliances and more teachers.

THE MODERN METHODS OF TRAINING DEMAND A GREAT INCREASE OF FACILITIES.

New necessities have arisen also from the rapid creation of new departments. More class rooms are needed to accommodate the instructors, and the expansion of the work requires more materials and more instruments. But when we look beyond ourselves and compare our own preparation for the work we have undertaken with that of other institutions and with the general progress in educational methods and appliances, the demand for the utmost development of our resources is strongly emphasized. Every kind of collegiate and university instruction has taken new forms. It is less mechanical and less restricted. The single text-book no longer serves as the full equipment of student or teacher. But it has become indispensable to have the use of many books for collateral reading, for reference and for research, and the use of many tools, instruments and machines, for experiment and for practice. And even the best equipment will soon become inadequate. The acutest and most highly trained minds are constantly directed to the improvement of books and apparatus. The best authority of this year may be obsolete next year, and the best instruments of the present may be antiquated and useless in the immediate future. The great wealth and enterprise of some of the colleges and universities of the country have given them a phenomenal growth. Their libraries immediately acquire every notable book in science or literature. Their laboratories immediately procure every improved appliance. To hold our own in the race, to do our part in furnishing the world with men educated according to the spirit and demand of the times, we must continue to meet new needs as they arise with as liberal a hand as our means will allow.

NEW BUILDINGS REQUIRED.

The buildings already begun will do something to supply the existing necessity for room. But they wlll come far short of meeting the whole requirement. Your attention has frequently been called to the inadequate provision for the military department. The situation grows worse every year. The battalion was never so large as at present, and the in-door space that it can use in bad weather was never so small. The drill hall so often asked for should be built as soon as the state of the funds will permit. Besides this, there should be a hall large enough to accommodate about twelve hundred persons, for the daily assembly of the students and for public lectures. The room at present in use will not seat more than two-thirds of the members of the university. It has been necessary to divide the students into two sections for chapel exercises, and on the occasion of any general meeting, such as a lecture, the anniversary of one of the literary societies, a literary contest, university or commencement day, a large proportion of those who should be present are unavoidably excluded. The present room would still have important uses, but as soon as possible a new hall should be provided either by an addition to the present main building or by the erection of a separate building designed wholly or partly for the purpose.

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The erection of the building for manual training will provide for all of the element-

ary work now done in the mechanical building, and thus create an opportunity for developing the work of mechanical engineering in its higher departments. This development is one which, as it seems to me, the interests of the university imperatively demand. The mechanical departments of many of the institutions of this class greatly surpass our own in their equipment and in their practice. Not only the best known institutions of the east, but others west and south, have extensive outfits for mechanical testing. This is a field of growing importance, and mechanical engineers who have not been well trained in it will have but a slender chance in the contest with those who have been more fortunate or more wise. On this subject I ask your attention to the forcible statement in the report of the professor of mechanical engineering.

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THE AGRICULTURAL DEPARTMENT SHOULD BE INCREASED.

The removal of the agricultural experiment station from the land of the university is a matter of regret, for it is desirable that there should be a close union of the work of the two institutions. But the loss will be in a large degree compensated by the additional opportunity which the agricultural department of the university will have for experimentation and practical instruction. The event thus falls in with the general movement of the university. While the other departments are increasing their appliances and broadening their work, the school of agriculture should be kept abreast with the foremost, and in order to do this land must be placed at its disposal, and money must be expended to provide the stock and implements necessary for the most effective instructional use of the land. I am sure that the Board is disposed to be liberal here and will not be satisfied till the department has been brought to a state of the highest efficiency.

A SYMMETRICAL DEVELOPMENT DESIRABLE.

As the university enters upon its larger career, the occasion suggests the wisdom of defining as clearly as possible the lines of its future policy, and of adjusting its functions to its probable conditions. Without a well digested plan there is danger that temporary reasons will sometimes prevail to the sacrifice of permanent well-being, and that instead of a regular and symmetrical growth, every new development arising naturally from the system and in turn imparting new strength and vigor to that from which it sprang, there will be attached here and there an incongruous department or school that will only consume means and energy and impair the operations of other departments. To unify and expand the present work and to make only such additions as will be homogeneous with it and will contribute to the completion of the general plan, may well commend itself as a subject of the very highest importance.

WHY THE PREPARATORY DEPARTMENT SHOULD BE DISCONTINUED.

The logic of circumstances is demonstrating the importance of discontinuing that part of our present work which is adequately done, both in method and amount, in other schools within the state. With high schools in every town and with numerous academies and normal schools, it seems hardly justifiable for the university to furnish instruction in the studies preparatory to the general and engineering courses. At present such instruction is furnished to about one hundred and ninety students. At their age most of them would be under the immediate care of their parents; the room they occupy is greatly needed by the students of collegiate rank; and the money expended in teaching them would add much to the efficiency of the higher departments. Besides all these points of advantage, the change would promote the dignity and standing of the university.

I do not propose that we should abridge the present opportunity offered by the

short courses in agriculture and mining. But the demands of these courses could be met with one-fourth the number of classes and sections that are now necessary.

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The chief gain would be the concentration of means and of the energies of the teachers on the higher work, leaving to the public schools the work that they were designed to perform and that legitimately belongs to them and not to the university. The work that legitimately belongs to the university is more than its present endowment will enable it to do. The call for funds to equip and enlarge the departments which are recognized as of paramount importance continually admonishes us against expenditure for objects that are foreign to the true work of the university.

If a self-supporting preparatory school whose teachers and courses of study should be subject to the approval of the trustees were organized at some distance from the university, the main objections to the present arrangement would be obviated, while the advantage of a more direct personal management would be secured.

SUPERIOR, TECHNICAL AND SCIENTIFIC EDUCATION DEMANDED BY THE PRESENT AGE.

All agree that scientific and technical instruction has a primary claim to recognition in any policy that may be adopted for the university. The physical and natural sciences and their applications in the industries of life are assigned a leading place by the law to which the institution owes its origin and the laws by which its endowment has been enlarged. This province has a special claim also in its own right. The tendency of the times, seen in the rapid growth of manufacturing, the opening of new forms of industry, the extension of railroads, the multiplication of engineering structures of every kind and magnitude, the increasing need of scientific knowledge and skill in agriculture, and the spirit and attitude of the general intelligence, call for men familiar with the knowledge and trained in the methods that will be of service to society in what are called the practical pursuits. It is a province also which most of the older institutions of learning have not occupied and which many of them do not choose or are not able to occupy. The scientific and technical college requires a far greater income than is needed for the work of that class of colleges—it must have a much more extensive equipment in buildings, laboratories, libraries and teachers, and must therefore have a much more liberal support. Here is a broad territory which the policy of the university clearly ought to include.

THE UNIVERSITY OF THE FUTURE.

While the lowest grade of work now done by the university ought to be cut off, there is at the other extreme an open and limitless field. Knowledge is daily increasing and the pressure of new or extended studies for recognition in the courses of instruction is enormous. By the addition of elective studies some of the courses already present twice as much grouud as the student can occupy within the time required for a degree; but the universities of the future will be those that build another story at the top of the present system, and establish libraries, plant laboratories, and employ teachers for a range of study that lies beyond the boundaries of the present college course. Ohio should have such a university. Here the student of science, both theoretical and practical, of history, literature, philology or philosophy should be carried forward both by instruction and by research to the utmost limit of the latest knowledge. Here, also, the light of creative genius should sometimes shine forth and in the progress of time the glory of new knowledge should gather upon the brow of the university. All this should be provided as time advances by extended post-graduate courses in every department of knowledge.

We owe much to the generosity of the state. Her recent bounty claims hearty

gratitude. Indeed, when we reflect on the object for which these appropriations have been made and on the nature of the results that are all but certain to flow from them, it seems impossible to over-estimate their value. Neither would it be easy to exaggerate the responsibility that rests on those, whose duty it is to apply this great benefaction to the purposes for which it was given. And yet, great as is the benefit received, it will but meagerly fulfill the demand. The work needing to be done spreads before us far beyond our power to accomplish.

OTHER STATES ARE RIVALLING OHIO.

What has been done by Ohio, munificent though it seems, is surpassed by some of her sister states. Younger and poorer states are giving more. With such institutions as Cornell University, having an annual income of three hundred thousand dollars, and the University of Michigan, annually expending an equal sum; with such endowments as that of Harvard University in the east, amounting to more than seven millions of dollars, and that of the Leland Stanford University in the west, reaching twenty millions, the humble revenue of a hundred and fifty thousand dollars which the Ohio State University can boast, seems a very modest if not a pitiful sum. Let us not forget to be grateful, or to estimate at its full value the benefaction of the state; but neither let us err by conceding that the state has done all that needs to be done or all that she ought to do.

Here and there are signs that private benefaction will not long be wanting. The will of the late Hon. Henry F. Page, of Circleville, bequeathing all his estate to the university, subject to the life estate of his wife and daughter, is a noble monument to his name. The estate is estimated to be worth one hundred and fifty thousand dollars. We can not but hope that so worthy an example will be followed by many men of wealth. Others have under consideration donations which, if they are made, will greatly enhance the usefulness of the institution. May the day soon come when every rich man in Ohio will feel it his duty to give enduring usefulness to a part of his fortune by adding it to the endowment of the university.

The new eminence to which the university has risen, we may well believe, will lead to a continued and rapid growth in wealth and numbers. It remains for those who are charged with the administration of its affairs to strive to develop here, such a university as will fulfill the need of the time and meet the just expectation of the people of the state.

Respectfully yours,

W. H. SCOTT,
President.

The following statistics from the report of the Professor of Drawing, show the attention given to drawing during the year.

REPORT ON DRAWING.

To the President of the University:

DEAR SIR: I respectfully submit the following report of the department of Drawing for the year ending June 24, 1891:

The number of students enrolled in the several classes was as follows:

Fall term—

Freehand drawing, Freshman	29
" Sophomore	28
Projection " "	53
Special drawing	3
Total for the term	113

Winter term—

Freehand drawing, Freshman	23	
" Sophomore	30	
Descriptive geometry, "	45	
Mechanical drawing (short mining course)	4	
Special drawing	3	
Total for the term		105

Spring term—

Freehand drawing, Freshman	26	
" Sophomore	31	
Lettering, Freshman	54	
Shades, shadows and perspective, Sophomore	37	
Photography, Junior	16	
Special drawing	6	
Total for the term		170
Total for the year		388

The total enrollment for the preceding year was 277, thus showing an increase in the total enrollment of 111.

A course in photography has been introduced and facilities for it provided.

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If the number of students increases as rapidly as in the past year, it will be with difficulty that the work can be carried on with our present accommodations. The department has reached that point in its growth where larger and better arranged quarters are imperative. It is a fact that the department has never been in possession of quarters in which the work could be carried on to the best advantage, and I hope that, in some of the new buildings to be erected in the near future, rooms will be provided for this department, designed, lighted and arranged to suit the work.

Before closing this report, I wish to express my thanks to Professor Brown for kindly allowing me the use of his recitation room, many times to his own discomfort.

Very respectfully,

JOS. N. BRADFORD,
Assistant Professor of Drawing.

OHIO STATE UNIVERSITY, *July* 1, 1891.

The full report of the Professor in charge of the Department of Mechanical Engineering follows:

REPORT ON MECHANICAL ENGINEERING.

To the President of the University:

DEAR SIR: I present the following report of the department of Mechanical Engineering, for the year ending June 24, 1891:

The number of students enrolled in classes was as follows:

First Term—

Thermodynamics	2
Analytical mechanics	18
Design drawing and invention	8
Mechanism	7
Mechanical laboratory	41
Total	76

Second Term—

Analytical mechanics	16
Mechanism	8
Prime movers	2
Mechanical laboratory	48
Total	74

Third Term—

Strength of materials	16
Mechanism	7
Machinery and millwork	2
Technical drawing	8
Mechanical laboratory	44
Total	61

Compared with last year's report, all classes mark a very considerable increase in the number of students attending, with the exception of thermodynamics, prime movers, and machinery and millwork, which follow as dependencies, in the order named as one class through the year.

INCREASED ACCOMMODATION FOR CLASSES NEEDED.

On account of this increase, much difficulty has been experienced recently in providing for the classes, on account of lack of room and facilities in the mechanical building. There being only one lecture room in the building, two classes have often been in attendance, unavoidably, at the same time; first, for want of room, and second, for want of teaching force. This plan, though possible for classes in drawing and other subjects where no larger than those of the past year, is at the same time ill-advised, and can not be carried on when the classes become still larger; and the present rate of increase will soon make more room a positive necessity, as well as more teachers to meet and do justice to those classes in the several rooms. For instance, during the past year the class in machinery and millwork and that in technical drawing have met simultaneously in the one room of the building. Considerable disturbance of the one class by the other, in such case is unavoidable.

And these hampering circumstances will be further augmented by the fact that to remain on a par with mechanical schools around us, we must soon extend the higher mechanical laboratory practice, or experimental engineering beyond what we now have, to include a fair course of the testing of boilers, of engines, of lubricants, of pumps, of flow of fluids, of condensers, of injectors, etc. One step in the direction of meeting this want is already made in the new course where higher mechanical laboratory is specified.

The present high importance of these questions is evident in the fact that inquiries have come to us as to the extent to which we are equipped for this instruction, and the fact that the American Society of Mechanical Engineering has laid down rules for conducting some of these tests.

This sort of instruction entails its due amount of labor for the teacher, raising the demand for an assistant still beyond that occasioned by larger classes and more class rooms.

I therefore respectfully ask early attention to these matters, regarding them as of importance equaling that of the department itself, viz:

1st. The securing of additional room for class work.

2d. The procuring of appliances and establishment of an experimental engineering testing laboratory.

3d. The employment of an assistant in the department qualified for the work indicated.

To meet these demands I would respectfully suggest that until a new mechanical building can be put up, an addition be put on the east side of the present mechanical building, providing more rooms for class work, and for museum purposes. Also, for the experimental engineering work, I suggest that the machine room and the north wing of the present building be given to that as soon as the manual training building and school can be established, when these rooms may be relieved of their present elementary practice work by transfer into the manual training building, which transfer I will mention again.

The procuring of appliances for this experimental engineering will involve considerable expense; probably about $10,000 to make the laboratory what it should be, including a first class steam engine fitted with condenser, reheater, steam dryer; dynamometers; a compound engine with same or like accessories; a gas and an air engine; an injector; a steam tester and colorimeter; water tanks with weighing scales and thermometers; steam pumps; stand pipe for hydraulic experiments; apparatus for flow of fluids; and others, for tests that will suggest themselves from time to time, as well as an improved testing machine.

The assistant must be a graduate, because to be capable of conducting the work of the testing laboratory, he must be acquainted with the higher principles of mechanical engineering; but he may be a recent graduate, one succeeding another, each serving for such comparatively short term of years as a moderete salary will warrant.

Allow me to remark that the above outlined laboratory for experimental testing is not a visionary scheme, as several of the best schools of the country already possess similar equipment, and there is ample reason why Ohio should be second to none in its resources for turning out mechanical men of the highest qualification.

PROPOSED MANUAL TRAINING SCHOOL.

When the manual training school is established, I should be glad to turn over to it all the elementary practice as now carried on, including that of the mechanical students subject to the condition at present in force for the departments of agriculture, mining and mechanical engineering, viz.: That the instruction be varied to fit the student, according to requests from those departments. In employing a professor to take charge of that school, I would respectfully request that a like condition as expressed above be understood and accepted; when all the present work can advisably be taken into that school, together with most of the tools and appliances for elementary mechanical practice that are now or may be in the mechanical building, a small reserve being probably advisable.

When the present mechanical practice rooms are thus relieved, the same rooms may be taken for the experimental testing laboratory described above.

SUGGESTIONS OF PRACTICAL USES FOR NEW MACHINERY.

I would suggest that the steam machinery for testing as above explained may be put to use for a central power station to run dynamos, from which power may be transmitted to various points where needed, as in running ventilating fans, pumps, lathes, or any machinery in the mechanical, electrical, chemical or manual training departments.

All such machinery will become valuable for purposes of experimental testing, and thus serve to augment the available apparatus of the experimental testing laboratory.

Should the present new boilers be removed to another boiler house, I would ask permission to have that boiler so set up that experiments with it may be made by students in the way of boiler tests. For this there should be means for weighing of fuel and feed water; of making temperature tests of fire and chimney, and for testing the dryness of steam.

I would respectfully urge the earliest practicable introduction of the above outlined changes.

Very respectfully yours,

S. W. Robinson.

The latest catalogue* at hand confirms the statement of the Trustees Report as to the present prosperous condition of the University. It begins with a showing of the relations between

THE UNIVERSITY AND THE STATE.

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In accordance with this act (the U. S. Land Grant Law of 1862) the Ohio State University was founded by the State as a public institution of learning. The governing body of the institution is a Board of Trustees, appointed by the Governor of the State for terms of seven years, as provided in the law organizing the University. The original endowment has been supplemented, and the objects of the University promoted by a permanent annual grant from the United States, under an act of 1890, by special appropriations of the General Assembly, and lastly, in 1891, by a permanent annual grant from the State. In accordance with the spirit of the law under which it is organized, the University aims to furnish ample facilities for liberal education in the arts and sciences, and for thorough technical and professional study of agriculture, engineering in its various departments, veterinary medicine, pharmacy and law. Through the aid which has been received from the United States and from the State, it is enabled to offer its privileges, with a slight charge for incidental expenses, to all persons, of either sex, who are qualified for admission.

ORGANIZATION OF THE UNIVERSITY.

The University comprises the Collegiate Department, the Law School, and a Preparatory Department. The Law School has a special Faculty, distinct from the University Faculty.

The Collegiate Department embraces the following Schools: Arts and Philosophy, Science, Agriculture, Engineering, Pharmacy and Veterinary Medicine. Each school is under the direction of a standing committee of the Faculty, having power to act in all matters pertaining to the work of students in the school, in the transfer of students from one school to another, and in matters of minor discipline.

LOCATION AND MATERIAL EQUIPMENT OF THE UNIVERSITY.

The Ohio State University is situated within the corporate limits of the city of Columbus, two miles north of the Union depot and about three miles from the State Capitol. The University grounds consist of three hundred and thirty acres, bounded east and west by High street and the Olentangy river, respectively. The western portion, of about two hundred acres, is devoted to agricultural and horticultural purposes, and is now under the management of the State Agricultural Experiment Station. The eastern portion is occupied by the principal University buildings, campus, athletic and drill grounds, a park-like meadow and a few acres of primitive forest.

The grounds are laid out with care, are ornamented with trees, shrubs, and flower beds, and are so managed as to illustrate the instruction in botany, horticulture, landscape gardening, and floriculture.

There are ten buildings, which are each described. "University

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*Catalogue of the Ohio State University for 1891–'92. Second Edition. Columbus, Ohio. Published by the University. 1892. Pp. 133.

Hall," "a four story brick building 235 feet in length, by 109 wide, was the first, and for a long time, the only building devoted to instruction." The Mechanical Building was erected in 1878. The Botanical Building in 1883. The Electrical Laboratory in 1889. The Chemical Building in 1890. "Orton Hall," to have the geological collection in 1892.

THE MANUAL TRAINING BUILDING.

Hayes Hall.—This large building, to be devoted to instruction and work in manual training, is now in process of erection. The walls will be built of pressed brick with trimmings of brown stone. The entire length of the building will be one hundred and sixty-eight and the depth one hundred and forty-six feet. The central portion will be three stories high and the wings each two stories high. On the first floor will be a reception room, an office, a reading room, two recitation rooms, rooms for instruction in cooking, a shop for iron work, a forge room and a foundry. The second floor will contain a mechanical museum, recitation and private rooms, a room for instruction in sewing, and a shop for wood work. The third story will be used for instruction in drawing, modeling, wood-carving and photography.

There are three other buildings, viz: a "Veterinary Hospital," and two "Dormitories."

THE LIBRARY.

The Library contains about 12,000 volumes, exclusive of pamphlets. Several special collections of books, which are incorporated in it, add to its interest and value.

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The library is of recent formation; and being designed especially for the use of the several departments of instruction in the University, in all purchases their most urgent needs have been constantly kept in mind, and none but books of recent issue or older works of permanent value selected. The collection, therefore, includes little that is obsolete, curious or merely entertaining. Annual additions are made to all the departments represented in the Library. During the past year nearly four thousand dollars has been expended for books and periodicals. About ninety periodicals are regularly received.

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The Library is a circulating one for both officers and students. In the reading room all students have free access to a collection of cyclopædias, dictionaries and works of reference in the various departments of study; graduate and senior undergraduate students are usually admitted to the alcoves. The management of the Library is vested in a body known as the Library Council, which consists of six members, as follows: The President of the University and the Librarian, *ex-officiis*, and four professors elected by the Faculty for a term of two years each.

The State Library, in the State House, containing about sixty-two thousand volumes, is accessible to students and forms a valuable auxiliary to the University.

The Public Library of Columbus may also be used by students.

For the students in the Law School, the State Law Library, in the State House, is of the greatest value. It is the largest and most complete law library in the State, and consists of about fifteen thousand volumes. It contains complete sets of the English, Scotch, Irish, Canadian, United States and State reports, statutes and digests, and the important legal text books and periodicals.

The Museums.—The Geological Museum.

The geological museum of the University has been collected and arranged with reference to instruction rather than display. The basis of it is a large and comprehensive collection of the rocks, fossil and economic minerals of Ohio.

There are also Zoological and Botanical Museums.

The Manual Training School.

The Board of Trustees, pursuant to the recent act of the General Assembly, is making liberal provision for a school of manual training. Plans and specifications for a new building for this branch of industrial education have been adopted and the building is now in process of erection. It is expected that it will be ready for occupancy in December, 1892. When completed the building will be furnished with the most improved equipment, and an extended and thorough course of instruction will be adopted.

Military training is given under direction of an officer of the regular army detailed for that service.

The expenses of a student in the Collegiate Department for a year may be estimated as follows:

	Low.	Moderate.	Liberal.
Incidental fees	$15.00	$15.00	$15.00
Laboratory fees	....	15.00	54.00
Books and Stationery	15.00	25.00	40.00
Room	4.50	37.00	75.00
Furniture	10.00	....	....
Board	70.00	110.00	150.00
Uniform	20.00	22.50	25.00
	134.50	224.50	359.00

The second and third estimates for room include light, fuel and care. The third one is for a room occupied by a single student.

The requirements for laboratory fees and books, depend upon the course of study pursued. The estimates do not include clothing (except uniform) or traveling expenses.

The collegiate work of the University is divided into six schools. These are "Arts and Philosophy;" "Science;" "Agriculture;" "Engineering;" "Pharmacy;" "Veterinary Medicine."

Each school is under the direction of a standing committee of the Faculty, having power to act in all matters pertaining to the studies of students in the school, in the transfer of students from one school to another, and in matters of minor discipline.

The regular courses leading to degrees are of four years; except those in Pharmacy, and Veterinary Medicine, which have only a three years course. There are, also, "short courses" in Agriculture, and in Mining, not leading to Degrees.

The general conditions of admission are as follows:

ADMISSION.

The University is open to both sexes. There is, however, no special course for women, or special study, elective or otherwise, such as music or painting; but in

the latter the Assistant in Drawing will receive private pupils. Neither is there a hall for the residence of women. They are assisted in finding boarding places in respectable families; but the Faculty is not so situated as to exercise supervision over their conduct out of college hours. Parents who send their daughters to the University should therefore be well satisfied as to their discretion, or else should place them under the care and control of the family with which they board.

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Candidates for admission to the Course in Arts, Philosophy, Science or Agriculture must be at least sixteen years of age; candidates for admission to any of the Courses in Engineering must be seventeen years of age.

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Rules and Regulations.

AMOUNT OF WORK.

No student is permitted to take less than fifteen or more than eighteen hours a week of class-room work, except by special permission of the committee of the School in which he is enrolled; and no student will be permitted to take more than the regular work of the class to which he belongs, who has not passed all of his work for the preceding term.

ELECTIVE STUDIES.

All elections of work in continuous studies, when once made, are understood to be made for the entire collegiate year.

The right is reserved to withdraw the offer of any elective study when it is not chosen by at least four persons.

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Courses of Instruction.

The instruction given in the Collegiate Department of the University embraces a wide range of subjects. Detailed information concerning the Courses offered in any subject will be found under the proper head, in accordance with tbe following classification:

Agriculture.
Agricultural Chemistry.
Astronomy.
Botany.
Civil Engineering.
Drawing.
Electrical Engineering. (See Physics and Electrical Engineering.)
English and Rhetoric.
French. (See Romance Languages.)
General Chemistry.
Geology.
German.
Greek.
History.
Horticulture.
Italian. (See Romance Languages.)
Latin.
Mathematics.
Mechanical Engineering.
Metallurgy.
Mine Engineering.
Military Science and Tactics.
Pharmacy.
Philosophy.
Physics and Electrical Engineering.
Physiology.
Political Science.
Romance Languages.
Spanish. (See Romance Languages).
Veterinary Medicine.
Zoology and Entomology.

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These courses follow in the catalogue in detail. The courses in "Drawing," and in "Mechanical Engineering" are here given: There is a course in "Electrical Engineering."

DETAILS OF COURSES IN DRAWING.

1. Freehand Drawing—Individual attention given. Outline drawing from copy and wooden models. Charcoal and crayon drawing from copy and plaster casts.

First, Second and Third Terms.—Once a week. Two hours' drawing.

Mr. Taylor.

Required in the first and second terms of the Freshman year of the Courses in Engineering, and the first term of the Short Mining Course. Elective in Sophomore year of the Arts, Philosophy and Science Courses.

2. Lettering—Lectures and practice.

Third Term.—Twice a week (four hours' practice).

Lectures.—Care and manipulation of draughting instruments. Proper construction of letters. Proper construction of titles.

Practice.—Nine plates of letters and figures.

Assistant Professor Bradford.

Required in the Freshman year of the Courses in Engineering and in the second year of the Short Mining Course.

3. Mechanical Drawing—Lectures, recitations and practice.

First Term.—Three times a week. Text-book: Faunce's "Mechanical Drawing." One hour lecture and recitation. Four hours' practice in drawing sixteen plates.

Second Term.—Five times a week in the Civil Engineering Course. Three times a week in the other Engineering Courses. Text-book: Church's "Descriptive Geometry." Two hours' lecture and recitation. Six hours' practice and fifty plates in the Civil Engineering Course. Two hours' practice and twenty plates in the other Engineering Courses.

Third Term.—Three times a week. Text-book: Church's "Shades, Shadows and Prespective." One hour lecture and recitation. Four hours' practice in drawing fourteen plates, using the technical colors to represent different materials.

Assistant Professor Bradford.

Required in the Sophomore year of the Engineering Courses and in the first term, second year, of the Short Mining Course.

4. Practical Draughting and Blue-Printing—Lectures and practice.

Second Term.—Three times a week (six hours' drawing).

Assistant Professor Bradford.

Required in the second year of the Short Mining Course.

5. Technical Drawing—Machine Designing and Drawing. Lectures and practice.

First Term.—Three times a week (six hours' practice). Lectures on machine designing. Practice. Designing machine parts, and drawing and blue-printing them ready for construction, showing form and dimensions.

Assistant Professor Bradford.

Required in the Junior year of the Courses in Mechanical and Electrical Engineering.

6. Technical Drawing.

Third Term.—Five times a week. Lectures on rules and methods for detail drawing, and practice in making same favorably to present the form, dimensions, etc., to the workman in practice. Line shading of drawings.

Professor Robinson.

Required in the Junior year of the Course of Mechanical Engineering.

7. Photography—Lectures and practice.

First Term.—Twice a week (four hours' practice).

Lectures.—Optics of photography; chemistry of photography; exposing and developing; printing; orthochromatic photography; lantern slides; applications of photography.

Practice.—Out-door photography; interior photography; flash-light photography; copying; lantern slides; printing; instantaneous photography; applications.

Third Term.—Same work as first term.

Assistant Professor BRADFORD.

Required in the Senior year, first term, of the Course in Mining Engineering, in the third term, Senior year, of the Course in Mechanical Engineering, and in the third term, Junior year, of the Course in Civil Engineering.

EQUIPMENT.

The facilities provided for the illustration and practical training in the above Courses are: For Freehand Drawing: Flat and shaded copies, wooden models, plaster casts, and easels and tables to work on. For Mechanical Drawing: A set of the celebrated Schröder models, O. S. U. improved drawing tables to work on, and a collection of shop drawings. For Photography: A well arranged, ventilated, and equipped dark room, printing outfits, enlarging, reducing and copying camera, four view cameras, lenses of long and short focus, flash lamp and a Prosch triplex shutter for instantaneous work. For Pen Drawing: A well selected line of work from eminent artists. The library contains a choice collection of books pertaining to the work of the department.

DETAILS OF COURSES IN MECHANICAL ENGINEERING.

1. ELEMENTARY MECHANICAL LABORATORY.

Three Terms.—From three to five times a week. Exercises preparatory to pattern making in wood. Exercises in smith work, including the elementary operations of the blacksmith, such as drawing, upsetting, bending, punching, welding; in moulding and casting, including sand moulds, cores and casting in iron and brass; in chipping and filing, in which a good number of forms are executed by cutting and filing at the bench; in hand turning in iron and brass in the hand lathe; in engine lathe work, in turning and fitting; in drilling and boring.

Professor ROBINSON, Mr. HAINES and Mr. COMBS.

Required in the Courses in Mechanical and Electrical Engineering, and portions of it in the Courses in Agriculture and Mining Engineering.

2. ADVANCED MECHANICAL LABORATORY.

Three Terms.—From three to five times a week.

An advanced course in advanced metal work, including grinding and measuring as in producing accurate standard plugs and rings; oil testing; dynamometric measurement; use of steam engine indicator; testing of materials of engineering; efficiency of boilers and engines; experiments in flow of fluids

Professor ROBINSON.

Required in the Course in Mechanical Engineering.

3. MECHANISM.

First Term.—Twice a week, and,

Second Term.—Five times a week. Lectures on the principles of elementary combinations of mechanism.

Third Term.—Three times a week. Accurate laying out of a movement, designing and constructing of same in material.

Professor ROBINSON, Mr. HAINES.

Required in the Junior year of the Course in Mechanical Engineering; the first and second terms required in the Course of Electrical Engineering.

4. INVENTION, DESIGNING AND DRAWING.

First Term.—Three times a week. Lectures on machine designs and original designing of machine parts, and on invention of machines, and a course of five or more original inventions, and parts fully designed and drawn ready for construction.

Professor ROBINSON, Assistant Professor BRADFORD.

Required in the Senior year of the course in Mechanical Engineering.

5. INVENTION AND DESIGNING.

Third Term.—Five times a week. A second course of invention, designing of some machine, and detailing and drawing of same complete, as in office work practice. A subject is chosen which involves the necessity of calculations as based on most of the principles previously taught in the course.

Professor ROBINSON.

Required in the Senior year of the Course in Mechanical Engineering.

6. ANALYTICAL MECHANICS.

First and Second Terms.—Five times a week. Lectures accompanied by Bowser's Mechanics, including statics and kinetics.

Professor ROBINSON.

Required in the Junior year of the Courses in Engineering.

7. STRENGTH OF MATERIALS.

Third Term.—Five times a week.

1st. Lectures, and Wood's book on Elastic Resistance to tension, compression, flexure, torsion.

2d. Lectures and text-book on Ultimate Resistance to Rupture by tension, compression, flexure, torsion.

3d. Lectures on allowed maximum-stress in structures, and the various modes of determining it, including Factor of Safety. Absolute Modulus of Safety, Rational Limit of Safety, and Wöhler's Laws.

4th. Two weeks of the term. Lectures on hydraulics; on flow of water through orifices, weirs, pipes, streams, and the gauging of streams. Adaptation of formulas to flow of gases at constant density.

Professor ROBINSON.

Required in the Junior year of the Courses in Engineering.

8. THERMODYNAMICS.

First Term.—Five times a week. Lectures on the action of heat. General equations, isothermal, adiabatic, and isodiabatic lines. Indicator diagrams of perfect engines. Rankine's and Wood's "Thermo-dynamics" serves as accompaniment.

Professor ROBINSON.

Required in the Senior year of the Mechanical Engineering and Electrical Engineering Courses.

9. PRIME MOVERS.

Second Term.—Five times a week.

1st. Lectures on heat engines, including hot air, steam, and gas engines.

2d. Water motors, including impulse wheels, turbines, breast and overshot wheels, water engines, wind wheels. Rankine's "Prime Movers" and Wood's "Thermodynamics" in accompaniment.

3d. Lectures on valve gears, governors, fly-wheels and fluctuation of speed, counterbalancing, quiet running and economy.

Professor ROBINSON.

Required in the Mechanical and Electrical Engineering Courses.

10. MACHINERY AND MILLWORK.

Third Term.—Five times a week.

Lectures on efficiency of elementary combinations of machinery, strength, endurance, friction, shock, adaptation of materials; fly-wheels for machines; transmission of power and machinery for the same. Rankine's "Machinery and Millwork" in accompaniment.

Professor ROBINSON.

Required in the Mechanical and Electrical Engineering Courses.

EQUIPMENT.

The Mechanical Building contains:

1st. One room equipped with hand tools, work-benches, tool cases and material for wood work for eight persons at one time.

2d. One room with a cupola for melting iron, a brass furnace, a moulding floor with sand, flasks, ladles, etc., where castings in iron and brass are made and used in the laboratory practice. Eight persons can find places here at one time.

3d. One room for forging, containing four forges, anvils and equipment, with power blast.

4th. One room with machinery and tools for iron work, with twenty-eight tool cases and room for twenty-eight persons at a time. There are seventeen vises, and corresponding bench room, four engine lathes, four hand lathes, one drill press, one planer, one universal milling machine, one shaper, one universal grinding machine, one surface grinding machine, and two tool grinders.

5th. One room containing a Thurston oil tester, a Riehle testing machine, a dynamometer, a Westinghouse compressed air apparatus, a Leffel turbine, and a cabinet of models of mechanical movements, a collection of standard "plugs and rings," snap gauges, screw gauges, mandrel reamers, three measuring machines, twist drills and screw tools, and samples of manufactured articles.

The engine furnishing power to the Mechanical Building is fitted up for indicator work, as also the engine in the Electrical Building, and the ventilating engine in the Chemical Building. In the boiler house are a Babcock and Wilcox boiler of 200-horse power and a tubular boiler of thirty-horse power, either of which serves for experiments on boilers.

The number of hours required each week in the different studies during the four years, in the several college courses, are given under each school; preceded by a general statement of the school. The general statements of the schools germane to this Report follow.

The School of Science.

STANDING COMMITTEE.

President Scott, *Chairman*; Professor Bohannan, *Secretary*; Professors Orton, Thomas, Kellicott. Bleile, and Associate Professors Chalmers and Denney.

COURSE IN SCIENCE.

The aim in this Course is to give the student not merely a good general knowledge of the various sciences, but that special and thorough training in some one of them, which results from prolonged study and laboratory work. To this end each student is required during the last half of the Course to specialize his work and to devote at least one-third of his time to one among the several fields in science open to his choice. At the same time the Course is so arranged as to permit him free election, for a considerable part of his work, from other scientific and non-scientific studies.

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The School of Agriculture.

STANDING COMMITTEE.

President Scott, *Chairman*; Professor Lazenby, *Secretary*; Professors Townshend, Robinson, Weber, Detmers, Kellicott, Bleile, and Kellerman.

This School embraces two courses: 1st, the Course leading to the degree of Bachelor of Agriculture; 2d, the Short Course in Agriculture, intended for those students who can spend but one or two years at the University.

The aim of the School is to give to young men a general education, and to fit them specially, first, for the pursuit of agriculture and horticulture in a rational manner; second, to fill positions as agriculturalists, horticulturalists botanists and agricultural chemists. To this end the University has provided and is constantly adding such instructional force and material equipment as are needed to give the most thorough and complete training in the subjects coming within the scope of these important branches of industry.

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THE SCHOOL OF ENGINEERING.

STANDING COMMITTEE.

President SCOTT, *Chairman*; Professor BROWN, *Secretary*; Professors ROBINSON, LORD, THOMAS, BOHANNAN, and EGGERS.

This School comprises the departments represented in the Courses in Civil, Mining, Mechanical and Electrical Engineering, and in the Short Course in Mining.

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COURSE IN MECHANICAL ENGINEERING.

This Course has for its first object the qualifying of men for the mechanical engineering profession. It aims to embrace preparation for such lines of pursuit as the successful management of machinery in manufacturing establishments; the superintendence of construction; the designing and laying out of machinery plants of mills and factories; the invention of machines for particular purposes, and the designing and drawing of the same, or of the inventions of others, preparatory to construction; the making of calculations or exercising sound judgment respecting strength, shocks, proportion, endurance and suitability of material for specific purposes, as steel in temper, composition metals, woods, etc.

The following statement shows the number and classification of the students for the year.

SUMMARY OF STUDENTS FOR 1891–92.

COLLEGIATE DEPARTMENT.		
Graduate Students		7
Undergraduate Students—		
Four-Year Courses:		
Seniors	34	
Juniors	39	
Sophomores	65	
Freshmen	133	
Special Students	40—	311
Course in Pharmacy		25
Course in Veterinary Medicine		21
Short Course in Agriculture		34
Short Course in Mining		25—423
THE SCHOOL OF LAW.		
Graduate Students	2	
Seniors	28	
Juniors	25—	55
PREPARATORY DEPARTMENT.		
Second Year	93	
First Year	88	
Irregular	6	187
		668
Deduct for names counted twice		4
Total		664

There are connected with the University in all its Departments, 66 "Professors, Instructors, and Officers" besides the President.

Rev. William H. Scott, M. A., LL. D., is President and Professor of Philosophy.

CHAPTER XIII.

U S LAND GRANT COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS—Continued.

ANALYSIS OF CHAPTER.

THE STATE AGRICULTURAL COLLEGE, FORMERLY KNOWN AS CORVALLIS COLLEGE, OREGON.

PRELIMINARY WORDS.

The Legislature of Oregon, which meets biennially, and would not meet again till too late to comply with the law, accepted at once, by act of October 9th, 1862, the conditions imposed by the Land Grant Law passed by Congress in 1862. Ninety thousand acres of the public lands were given to Oregon under this law.

There was then no State institution prepared to give the required instruction and, therefore, in 1868, the Legislature designated Corvallis College, a school established some years before by the Methodist Church South, to receive the income from the Land Grant Fund; and, as the lands had not then been selected, the Legislature made a small annual appropriation to enable this College to open and maintain the department required.

Partly owing to complications arising from this partnership between the State and the private institution, as well as to the growing facilities eventually made possible by the enactment of the law known as the "Hatch Act," in 1887, establishing Experiment Stations in the several States, and by the subsequent passage of the Supplementary "Morrill Act," in 1890; many of the questions relating to the nature and purpose of these Land Grant Colleges, are freely discussed in the various official reports, made from time to time, by the Board of Regents, and by the President of the College. As these topics are of very general interest, copious extracts have been taken from these reports.

This College has been fortunate in its Board of Regents and its Presidents, who each seem eager to develope the College in accordance with the most advanced ideals of modern Educators; whose beliefs and theories will be found to be well stated and ably advocated.

THE STATE AGRICULTURAL COLLEGE.

Corvallis College, situated at Corvallis , Benton County, Oregon, adopted as an Agricultural College, August 22nd, 1868, was, as already stated, designated by the Legislature in 1870, as "The Agricultural College of the State," to be the recipient of the income of the national land grant to the State; and was reorganized under this grant, November 2nd, 1870.

The course of studies, as first arranged by the Legislative Commissioners, provided a Preparatory course, and a College course of four years ; the latter embodying instruction in the higher English studies, the Natural Sciences, Mathematics, Languages, Agriculture and Military Drill.

Drawing, only appears among the Mathematical studies of Sophomore year as follows : "Trigonometry, (Plane and Spherical,) Nav-

igation, Mensuration, Surveying, Field Surveying, Drawing, Maps of Farms, etc."

In a special report to the Governor of the State, made in 1876 by R. S. Strahan, then President of the Board of Regents of the College, there occur the following comments in regard to the purpose of Congress, in passing the act "providing for the establishment of Industrial Colleges in the several States of the Union." * * * "It will be seen upon inspection that liberal and practical education in the several pursuits and professions of life" is the thing to be promoted, and not in two only, (Agriculture and Mechanic arts), as some do ignorantly talk, for it cannot be meant that men in all professions and pursuits are to be turned away from their several respective pursuits to devote themselves to agriculture and the mechanic arts. The great ideal of the law seems to be this. To bring education in agricultural science and in the mechanic arts, upon a level with education in all other pursuits. (I may here remark by parenthesis that our Legislature, in adopting a course of study for the Agricultural College, well understood the spirit of the law of Congress.)"

If the worthy President is correct in his understanding of the purpose of Congress in passing that law, he has most happily stated it; and has, also, stated the whole purpose of the movement among many educators, during the past 12 years, in promoting the introduction of industrial drawing in all the public schools of the country, namely: "to bring education in the Mechanic Arts upon a level with education in all other pursuits."

The catalogue of 1881–'82, shows the course of study distributed in seven schools; namely Physics; Mathematics; Moral Science; Languages; History and Literature; Engineering; Agriculture.

In regard to the School of Engineering, in which of necessity Drawing is a far more important study than in any of the other schools, the catalogue of 1881–'82, repeats the statement of all the previous catalogues. "School of Engineering. This Department cannot be fully organized yet, for want of funds. Besides what of this course is taught in the Schools of Mathematics and Physics, we teach Drawing and Descriptive Geometry, Shades and Shadows, and general principles of Civil Engineering. Text Books—"Warren," "Church," "Mahan."

Sixty young men of 16 years of age, and over, are entitled to free tuition as State pupils; all others pay moderate tuition. The College receives pupils of both sexes. The catalogue of 1881-'82, shows a total of 150 pupils, 60 of whom are girls. No record showing the distribution of pupils between the Preparatory school or the several College classes, is given.

In the "Fourteenth Biennial Report," made to the Legislature under date of December 20th, 1880, President Arnold, transmitting his report through the Governor of the State, suggests that the Legis-

lature memorialize Congress in favor of the "Hatch Bill," to establish Experiment Stations; he, also, urges the claims of Technical Education; and quotes freely from J. S. Russell, of England, and the late Mr. Stetson, of Massachusetts, in its advocacy. The following summary illustrates his ideal of the institution to be developed.

CONCEPTION OF A PRACTICAL EDUCATION, BASED ON SCIENCE.

A practical education based on science supposes three things—viz:

1. A certain amount of instruction in science;
2. A certain amount of instruction in technological studies;
3. A certain amount of instruction in practical application of principles.

For example, when a man farms, he applies principles to practice, and Agricultural education teaches him how to apply these principles well. Now in this case, scientific education enables him to understand the principles well; technical education teaches him to apply them well; and practical education applies them. Hence, if one school must teach all this, and in addition studies in a Mechanical Department, a very large corps of teachers, must be had and costly outfit must be used. Such school must have at least three faculties—

1. A Scientific and Literary Faculty;
2. A Faculty for Technical Studies;
3. A Faculty for Teaching the Operations.

The law organizing the Oregon Agricultural College contemplates an institution upon the broad basis above alluded to.

A summary of a four years course of the "technical studies of Rational Agriculture," is also given. "Drawing" enters in the two final years of the course. The President urges the need of a larger teaching force and of increased accommodations.—

A report to the President by F. Berchtold, teacher of modern languages including English, and Drawing, states that the "study of" Freehand Drawing "was introduced two years ago, and is of great practical use to the farmer as well as to the mechanic." He says the class of thirty-eight show great interest and are doing good work. The Professor of Mathematics and Engineering, Professor T. P. Branch, looks forward to the opening of courses in Mechanical Drawing, and in Shop work, urging their importance and feasibility.

As appears from the following report* made by the "Board of Regents" to the Governor of the State, this College, which heretofore had been a denominational college, to which the State had directed the income of the U. S. Land Grant Fund to be given; had, at last, become a State Institution. Owing to this important change in the character and the relations of the college, this report is here very fully quoted.

*Annual Report of the President of the Board of Regents of the State Agricultural College to the Governor of Oregon for the year ending June 30, 1890, Legislative Assembly, sixteenth regular session, 1891. Published by authority. Salem Oregon: Frank C. Baker, State Printer, 1891. Pp. 34 & 2.

THE STATE AGRICULTURAL COLLEGE.

To His Excellency Sylvester Pennoyer, Governor of Oregon:

SIR: The State Agricultural College of Oregon recognizes three great objects:

First—Education of young men and women in the several subjects ordered by the act of congress of 1862, namely, agriculture and the mechanic arts, not forgetting the other usual branches of a liberal education.

Second—The carrying out of the intentions of congress in establishing the experiment station, as a department of the college and by means of the special appropriation of $15,000 annually, under the Hatch act, approved March 2, 1887.

Third—The extension of knowledge of improved methods of agriculture and its allied sciences, and of horticulture and its various branches, among all persons interested by means of bulletins, published quarterly from the experiment station, and by farmers' institutes held under the auspices and direction of the college in various sections of the State.

This report falls naturally, therefore, under these three heads. Dealing then, first, with the State Agricultural College as a teaching institution in agriculture and the mechanic arts, and the usual branches of a liberal education, I must preface my description of the college as it is to-day, with a short sketch of its history.

HISTORICAL SUMMARY.

The Board of Regents appointed during the February session of the Legislature of 1885, did not assume the control and government of the college until July 2, 1888, when the new building erected by the citizens of Benton county was formally accepted by you, sir, as Governor of Oregon. Therefore, only two years, from July, 1888, to June 30, 1890, cover the whole history of the college under State control—a short time measured by months and weeks, but perhaps long enough to enable judgment to be passed on the plans formed by the State Board of Regents and the measures taken by them to carry such plans into effect.

The task assumed by the State board was no light one.

The Methodist Episcopal Church South had, first, assumed by official acts recognized by the Legislature of Oregon and adopted by the act of February, 1885, to relinquish to the State the control and management of the agricultural college, and had then, by means of a suit in equity against the individual members of the State Board of Regents, tried to nullify their acts and resume control.

All parties, save and except the representatives of the Methodist Episcopal Church South, accepted in good faith the acts of the Legislature of Oregon, approved as above mentioned, February 11, 1885, and confirmed by a second act approved November 21, 1885. The citizens of Benton aided by a few outside friends, proceeded to complete the subscription and payment of sums aggregating about $25,000, and the sums so raised were expended by the building association, with the advice and approbation of the State Board of Education, as provided in the act of February, 1885, in the erection and equipment of the new college building on the farm designated by the legislative act as the college farm, near Corvallis.

In this building—most admirably adapted to accommodate for teaching purposes upwards of 150 students—the agricultural college of Oregon, at last controlled and governed by the State of Oregon, through the Board appointed by the State, opened its session on September 12, 1888, with an attendance of about 40 students, closing that year, however, with 91 on the rolls.

THE EDUCATIONAL PLANS OF THE COLLEGE CAREFULLY CONSIDERED.

Much preparatory work had been accomplished by the Board of Regents, who had met at regular intervals from the time of their first appointment. The scheme of studies had been framed by a special committee of the board, of which Hon. Geo. W. McBride, Secretary of State, and Hon. E. B. McElroy, Superintendent of Public Instruction, were the most active members, and was only adopted after a most

careful scrutiny and long consideration by the full board. Prior to this, plans and methods of nearly all the agricultural colleges in the United States had been thoroughly analyzed and compared, and the course of study and management of the Oregon college is based on the results so laboriously obtained. The aim sought to be obtained was thoroughly technical education in "Agriculture and the Mechanic Arts," as laid down in the original act of Congress. To make this plan effective, a first-rate staff of teachers was necessary, imbued with a united and harmonious spirit of interest in their work for the work's sake, and a determination that the agricultural college of Oregon should be second to none in the quality of the teaching and the educational influence on the youth of Oregon there taught.

THE EDUCATIONAL FACULTY SELECTED WITH GREAT CARE.

No appointments have been made without long and careful inquiry into the character and attainments of the applicants. Such appointments are, by necessity of the case, experiments, and it cannot be wondered at that in a staff of a dozen men the board have considered it to be for the best interests of the institution as a whole that certain changes of men and modifications in subjects taught should be made in the course of the first two years of the new college?

NEED FOR PROVIDING FOR THE LIVING EXPENSES OF THE STUDENTS.

Another requisite for the usefulness of the school was that the charges must be low enough to enable the farmers' and mechanics' sons and daughters to attend without too heavy a drain on the parental purse, or better still, the cost must be set at a figure not too high to be covered by the savings of that most worthy class of students who prize the college opportunities enough to earn and lay by hardly-earned money to get there. For this end the students must be lodged and boarded by the college, advantage being also taken of the produce of the farm, garden, and orchard of the college to reduce the cost of living to the lowest point. But there were no buildings suitable for these purposes. The liberality of the legislature of Oregon was appealed to, and at the session of 1889 they responded by including in the appropriation in favor of the State Agricultural college then passed an amount which served, with the strictest economy, to build and furnish a student's hall for the reception of about 55. Very few then thought that by the end of 1890 accommodations for 150 students would have to be provided. But to make the teaching of agriculture and horticulture effective on a working scale, and at the same time to provide suitable scope for the experimental work called for by the Hatch experiment station act, much more farming land was necessary than was furnished by the 35-acre farm referred to in the act of 1885, and which farm had been purchased by public subscription of the citizens of Benton county for the benefit and purposes of the State Agricultural college many years ago.

EXTRAORDINARY GROWTH OF THE INSTITUTION.

For this purpose also the legislature of 1889 was urged to make an appropriation. They met these requirements also by providing the funds by which 155 acres of farming land, in proximity to the 35-acre farm and the college buildings, were purchased for $14,215.40 in the summer of 1889, and a handsome octagonal barn was built on the newly-purchased farm and fitted up with feeding stalls, silo, root house and storage room for hay and grain. These provisions also have now proved inadequate for the increased production of the farm. Technical teaching in the mechanic arts demands a building for carrying on working in wood and metal, some machines, of such simple kinds as are in common use, and a good supply of carpenters' and smiths' tools and implements. Funds for these purposes were also found out of the $30,000 appropriated by the legislature of 1889; a convenient two-storied workshop, with draughting room and recitation room attached, was built

of brick and partially supplied with machinery and tools—sufficient, at any rate, for the instruction in wood-working of a considerable number of students. The expenditure under this head has been about $7,441.

INDUSTRIAL TRAINING OF GIRLS, ALSO, TO BE PROVIDED FOR.

The Oregon State Agricultural college receives both male and female students. The scheme of instruction adopted by the board included, for the special benefit of female students, classes in household economy and hygiene. If the boys were to be practically taught how to lay out, manage and work a farm, garden, or orchard, the girls must be taught the household duties of the higher social life. To cook, to make and repair the family garments, to care for the preservation of individual and of family health, to tend the sick, to study how to beautify and adorn the home—all these duties lie within this most useful department. Even after the resolutions to establish this chair in the college had been taken it was a long while before the regents could satisfy themselves as to making the appointment. Finally Miss Margaret C. Snell, M. D., of Boston, lately of the Snell Academy of Oakland, was appointed, and the board have since seen reason to congratulate themselves, and above all, the lady students of the college, on the selection so made. A visit to the class room, filled with class after class of girls at work from early morning until the college day closes, will amply repay any one interested in the higher technical education of women to-day.

The facilities provided for thorough training in Horticulure, and its kindred sciences, are recited. Professor F. L. Washburn, B. A., (Harvard), was appointed in charge at the opening of the college year 1889-'90.

A thorough course in the usual English studies is required of all students.

MANUAL LABOR REQUIRED.

One of the features which distinguishes the course here from that of any other college or university in the State is, that one hour's practical labor is made compulsory daily on every male student. The nature of this labor varies with the season of the year, with the stage of the college course of any one student, and with the nature of the college course itself, whether agricultural, mechanical, or scientific. Besides this one hour of compulsory labor, a certain amount of money is allowed for students' labor in the agricultural and horticultural departments, to be distributed among such students as earn it by voluntary labor, at the rate of 15 cents per hour.

* * * * * * *

INCREASING ATTENDANCE.

The chairman of the executive committee was enabled to report to the board in March, 1889, that 104 students were in attendance—a gratifying increase on the forty-three of September, 1888. At this time upwards of 185 students are on the rolls, and an attendance of 200 is fully expected after the reöpening of the college from the Christmas vacation.

It is pleasant to note two changes in the composition of the classes: First, the area from which the students come is growing wider all the time, and the students at this time, as a whole, are older, more mature, and have been better taught previous to their entrance in the college.

In a list of Agricultural colleges of the United States for 1889 (kindly furnished by the courtesy of Hon. A. W. Harris, acting director of experiment stations, Washington, D. C.,) Oregon stood sixth from the foot of the list in number of students. If Oregon had been represented in that list by her present number of

students her place would have been thirteenth from the foot—a considerable change inside of two years. It is believed that the Agricultural college of Oregon has at this time more students in proportion to the population of the State than any strictly Agricultural college in the Union.

A comparison between the number of teachers and the students in the several classes in the Oregon college, with similar figures gathered from the catalogues of a number of the leading colleges, places Oregon in the front in this respect.

THE GREAT VALUE OF THE AID GIVEN BY THE U. S. GOVERNMENT, IN THE PASSAGE OF THE "NEW MORRILL ACT," RECOGNIZED.

The attendance of students is not likely to fall off now that the opportunities for usefulness are increased by the passage of the new Morrill act, approved August 30, 1890. This act places $15,000 at the disposal of the regents for the year ending July, 1890, and a sum of $16,000 for the current year 1890–91, with annual increases of $1,000 until the limit of $25,000 is reached. The first $15,000 will be chiefly devoted to increasing and improving the equipment of the college, subsequent appropriations to the current annual expenses. This course has been suggested by the association of American colleges and is being generally followed.

But as the present attendance of students has outgrown the present buildings, both for teaching, experimental and lodging purposes, the Regents are at a loss to know how any increased number can be accommodated. Congress only attaches one condition to its munificent grant, which is that no part of it shall be spent on buildings—such expense the several States must bear.

Therefore the legislature of Oregon must be appealed to, however reluctant the Board of Regents, and you, sir, as Governor, may be to appear before our law-makers to urge them to again give monies to this college which they generously favored in 1889. But there is no alternative.

There is also a full report of the "Experiment Station."

REPORT OF LEGISLATIVE COMMITTEE.

A report by the joint committee of the Legislature follows. This is brief but very strong in its approval of the management:

We find that the increase of students has been so rapid (the number present during the first year being 93, and now while only in the second quarter of the third year there are 200 registered) it is necessary that additional buildings be provided, or the Board of Regents will be compelled to advertise to the State that no more students can be received.

We believe that the people of the State are anxious to have the good influence of this school extended to the greatest number, and we therefore recommend that the necessary buildings be provided for the accommodation of the increasing number of students that we feel sure will want the benefits of an Agricultural and Mechanical education.

* * * * * * *

Perhaps contrary to the general impression, the proper equipment of one of these colleges is far more expensive, being at least ten times greater, than that of an ordinary classical institution. A college of agriculture and the mechanic arts is not a cheap affair, and the sooner we awake to the idea that it will and ought to cost something to spread the knowledge of facts and principles which will change the drudgery of common toil to the dignity and delight of intellectual and ennobling occupation, the better.

Respectfully submitted.

E. T. HATCH,	E. O. MCCOY,
R. M. VEATCH,	JUDSON WEED,
Senate Committee.	J. F. HENRY,
	House Committee.

This intelligent appreciation of the needs of such an Institution, and the cordial approval of its management, thus expressed by the Legislative Committee, are certainly matters for congratulation.

PRESIDENT ARNOLD'S REPORT TO THE UNITED STATES AUTHORITIES.

In his first Annual Report to the United States authorities, made for the year ending June 30th, 1891, under the law of 1890, to the Secretaries of the Interior, and of Agriculture, respectively, President Arnold, acting in accordance with the suggestions of the Commissioner of Education, gave an extended statement; showing the history of the institution, its progressive development, and its "present condition, resources, and prospects."

He says, in his opening words:

> The Agricultural College of Oregon has had during most of its existence a varied and fluctuating fortune. For fifteen or sixteen years after its first organization (for it has had two distinct organizations) it was under the control of a private church school, and the dissatisfaction in the public mind at this arrangement kept it from the prosperity it ought to have enjoyed; the most strenuous efforts were indeed required to keep the school alive. Since its new organization under the State control it has received new life and is now a growing institution, becoming more and more efficient as a means of educating the industrial classes. By the work of the College itself in tuition, bulletins, and farmers' institutes, the people are becoming aroused to the great importance of the Agricultural College, both as a social and as an educating power. The policy of the school is fixed in harmony with the Act of Congress of 1862, and may be expressed by saying that all its work must tend to create in the community an educated class of farmers, mechanics, and housekeepers. This policy the authorities are carrying out along two lines of work—the work of educating by tuition the youth who attend upon instruction in the College, and the work of educating the community at large by bulletins and farmers' institutes.
>
> The work for students takes three forms, first, a course of liberal instruction; secondly, a course of technical instruction; and thirdly, a course of practical instruction.
>
> The work for the community requires, first, that certain problems relating to agriculture be investigated; and secondly, that the results of such investigation be given to the public. This is done by bulletins and farmers' institutes.

President Arnold states, further, that the "experiment station" is treated as a part of the college; and that "all the members of the station staff are, also, Professors in the college." The Board of Regents, to insure united action, placed the control of the college and the station in the hands of the President of the College. He states that former dissatisfaction seems to be passing away and that the Community is more inclined to sustain the College. The authorities have succeeded in their efforts to make its advantages accessible at a minimum cost to the students, who can now obtain "board, lodging, lights, and heat in the halls, for nine dollars per month." The State has been liberal in providing buildings, and in the purchase of the college farm, while the Board of Regents have given "cordial cooperation and support." He enters at length into a

statement of the plans of work of the Station, which promise to be of value to the farmers of the State.

In the "history" of the college, the President recites the act of 1862 enacted by the Legislature in accepting the U. S. Land Grant. In 1868, commissioners were appointed for locating the lands. As there were no State Colleges in the State, the same Legislature designated Corvallis College, in Benton County, to receive the income from the lands when the fund had been formed. Until such time, small annual appropriations were made by the Legislature for the maintenance of the State College of Agriculture. "In 1885, the church relinquished (voluntarily) its claim on the funds of the Agricultural College," and the State resuming control, the Legislature passed an act directing its location, and providing for its government. President Arnold quotes at length from sections of this Act. The first one directs the continuing the college at Corvallis, provided the citizens will erect a building for it on the Agricultural College farm, to cost not less than twenty thousand dollars. A Board of Regents is incorporated and the general Government of the College vested in that body. The members of the State Board of Education, and "the Master of the State Grange for the time being", are made *ex-officio* members of this Board. Nine other members are to be appointed by the Governor; not more than five of whom are to belong to the same political party. The course of instruction is to be prescribed by the Board, and must be "in accordance with the objects sought by Congress in the establishment of State Agricultural Colleges, namely: instruction in agriculture and the Mechanic Arts." Free scholarships ("one-third of which may be females,") are provided, equal in number to the joint number of senators and representatives in the Legislature, with an additional one for each county.

The offer of the Church College to relinquish its claim for the control and management of the Agricultural College, is formally accepted. The statement by the President, which follows, is of interest as throwing some light upon the underlying causes of the fact so often complained of by those claiming to speak for the farmers of the country, namely: that the special training of the farmer is neglected in these Land Grant Colleges

He says·

While the church held the school from 1868–1888, agricultural science was regularly taught as an enforced study to such pupils as held free scholarships, and to such others as might desire to take agricultural studies; but I may remark in passing, that during my connection with the College (from 1872 to 1888) *there was never a single instance of a student volunteering to take agricultural studies*, so far as I remember. There was not then, and the same is true to-day, a generally felt need of scientific agricultural education.

Such feeling is of course a product of such education itself and hence the great importance of the agricultural Colleges; the desire once awakened, there will be no trouble about the education. Such conscious desire as does exist, exists in the

minds of the older people, and not to any appreciable extent in that of the young who ultimately settle the matter of their education.

While the church controlled the school, there was an attempt (and the same policy continues to-day) to popularize the College by taking advantage of the grange sentiment and by an attempt to bring the school largely under the influence of farmers, hence, there seems to exist to-day a tacit feeling that the agricultural College is designed especially for the benefit of the farmer, and that it is their school, emphatically, that it is their special business to foster it, manage it, and patronize it. Of course everybody in the State is equally interested in the institution, and should be made to know so, as soon as possible.

The people of Benton County erected the building as was required and the Governor having accepted it in 1888, the Board of Regents took charge, reorganized and prescribed courses of study which, after some revisions, still continue in force.

THE COURSES OF STUDY, AS PRESCRIBED BY THE BOARD OF REGENTS.

There are three courses of study, "Agriculture," "Mechanics," and "Household Economy."

In the first term of the first year these courses are alike, and comprise Algebra, English, History, and Bookkeeping, except that in that of "Household Economy", Sewing, is also taken. In the second term, Algebra, English, History, and Drawing are taken in all the courses; with Horticulture added in the courses in Agriculture and Household Economy, and Shop Work in that of Mechanics. Algebra, English, Drawing, and Chemistry are taught in all the courses of the third term with "Agriculture," "Mechanical Drawing," and "Sewing" added in their respective courses.

In the first term of the second year, Geometry, and Chemistry, are the common studies—Agriculture, and Horticulture, added in the course of Agriculture—Mechanical Drawing, and Shop Work, in Mechanics—Preserving, canning, and cooking of fruits in "Household Economy," with "Language" as an optional.

In the second term, Geometry is taken in the three courses; Chemistry in the first two; Modern History in the Girls' Course; Zoology in Agriculture and Household Economy; Mechanical Drawing in Mechanics; and Marketing, and Chemistry of Cooking, in the Girls' Course; with Language optional.

In the third term, Trigonometry, and Chemistry, in first two courses; English, in all three; Zoology, in Agriculture, and Household Economy; Shop work, in Mechanics; and Dressmaking, and Sewing, in the Girls' Course; with Language, optional.

In the third year, the courses decidedly differentiate.

In Agriculture, 1st term: Surveying ½, Roadworking, Botany, Physiology, Agriculture. 2nd term: Physics, Meterology, Physiology ½, Agriculture ½, Plant Physiology. 3rd term: Physics, Entomology, Botany, Political Economy.

In Mechanics, 1st term: Analytical Mechanics, Analytical Geometry, Elementary Mechanism, Drawing, Shop Work. 2nd term: Analytical Geometry, Calculus ½, Physics, Mechanism, Machine Design, Shop Work. 3rd term: Calculus, Political Economy, Physics, Steam Engine and Motors, Drawings and Design.

In Household Economy, 1st term: English Literature, Botany, Language (op-

tional), Dress Making and Millinery, Physiology. 2nd term: Special Hygiene, English Literature, Language (optional), Physiology ½, Physics or Meterology. 3rd term: House Furnishing and Kitchen Gardening, Political Economy, Language (optional), (two of these) Physics, Botany, Entomology.

In the fourth year the Courses for Degrees of B. S., B. M. E., B. L., are as follows: Bachelor of Science Course, 1st term: Analytical Geometry, Logic, Physics, Language. 2nd term: Analytical Geometry ½, Calculus ½, Minerology, Psychology, Language. 3rd term: Calculus, Ethics and Constitutional Law, Geology, Language.

Bachelor Mechanical Engineering Course, 1st term: Mechanics, Logic. 2nd term: Mechanics, Psychology. 3rd term: Mechanics, Ethics and Constitutional Law.

Bachelor of Literature Course, 1st term: English Literature, Language, Logic, Social Etiquette. 2nd term: English Literature, Psychology, Language, Sanitary Science. 3rd term: English Literature, Ethics and Constitutional Law, Language, Care of the Sick.

The Agricultural Department.

A remark common to the departments of Agriculture, Mechanics, and Household Economy may be made here. Since it is the business of the college to make scientific farmers, mechanics, and householders, it is necessary to give three kinds of training: 1. Training in general science. 2. Training in technical priciples. 3. Training in the practical application of these principles.

As students come to us wholly unprepared it is needful to give them instruction in general scientific knowledge, and one course of study is designed by its quality, quantity, and order of arrangement to give both general training and technical training, also the practical application of the principles is provided for by the rules of the Board of Regents that requires each student, male and female, to do manual labor at least one hour each day.

The agricultural course extends through a period of three years. The first year is for the most part a work of preparation for the technical studies coming in the second and third years. * * * Each student in this course is required to spend an hour a day for one term of the first year in the shops learning how to work in wood, and during the second year to spend the same amount of time in learning how to work in iron.

The completion of this course entitles the student to the degree of Bachelor of Scientific Agriculture.

Provision is made by a fourth year's course of study in more advanced science and literature for conferring the degree B. S., on such as desire it, and become entitled to it. The means for illustrating the principles of this course are ample. We have a farm of 180 acres furnished with all the needful appliances, barns, stables, machinery, tools, teams, stock, silo, and other things used on a well regulated farm.

The Mechanical Department.

The work of this department is analyogous to that of the Agricultural department, but differs from it in respect to time; extending through four years instead of three. The degree attained B. M. E., (Bachelor of Mechanical Engineering.)

Shop work in this course takes the place of farm work in the Agricultural. The student studies mechanical drawing and takes shop work in wood, the first year; in iron, the second; and in mechanics, the third. A sufficiently large and well equipped Mechanical Building is provided; with Machines, Blacksmith, and wood working shops, and a room for Drawing and one for teaching typesetting and printing.

DEPARTMENT OF HOUSEHOLD ECONOMY.

This department is intended to fit girls for the duties of housekeeping. The mistress of the f mily has to dispense what the master provides, and it is believed that this department is, therefore, the complement and counterpart of the Agricultural department; for the prosperity of the family depends as much upon the intelligence and skill of the food-divider as upon those of the food-provider. Industrial education should therefore be extended to girls as well as boys.

The girls are taught sewing the first year; cooking and fruit preserving the second; and dressmaking and millinery the third; horticulture, floriculture, and kitchen gardening, as legitimately woman's work, are taught; also, special hygiene.

Concurrently with these studies there is given a course of liberal instruction nearly identical with the liberal studies of the Agricultural course, more attention, however, being given to the English Literature. The course extends over three years and leads to the degree of bachelor of household economy. The degree B. L. (Bachelor of Literature) is provided for by a four years course of more advanced studies. The means for illustrating instruction in this department are ample and range from a cambric needle to a large cooking stove and several small ones.

These detailed courses are followed by statements of the work in chemistry, physics, botany, zoology, physiology, mathematics, history, English, etc. Freehand Drawing, bookkeeping, and history are required of all students. A table is given showing the amount of hours per year given to each study in schoolroom. There are nearly fifty subjects of study enumerated in this table. "All students are required to drill daily in the school of the soldier and of the company."

The terms of admission to the College are that the pupil be fifteen years old and be able to pass an Examination in Arithmetic, Elementary English Grammar, Reading and Spelling—a written Examination is required. A preparatory department is connected with the College, there being no special preparatory schools in the State. The State furnishes one hundred and twenty-three free scholarships. All other pupils pay a small tuition fee of fifteen dollars a year.

A detailed account of the year's work of the Experiment Station follows.

The number of students attending the College for the year ending June 30, 1891, is given as 196, 72 of whom are girls. Seventy three are in the "Preparatory" Classes, of whom 25 are girls. The Faculty numbers 12 Professors and Instructors, one of whom is a lady.—B. L. Arnold, A. M., President.

The exigency caused by the sudden death of President Arnold, and the consequent calling of a new President to take the future direction of this new departure of the college, gives especial interest both to the attitude of the Board of Regents, in regard to this development; and to the ideal which the President will seek to embody. It is, for this reason, that these two reports are so largely quoted from, and that that of President Bloss is given almost in full.—

Whatever is true in relation to these new forms of training, which

being here about to be introduced are naturally fully discussed, is as true for similar institutions in all parts of our country; and, therefore, is of general interest.

The latest Annual Report of the Regents * begins as follows:

To His Excellency, Sylvester Pennoyer, Governor of Oregon:—

SIR:—It becomes once more my duty, as President of the Board of Regents of the State Agricultural College, to present a report of the condition and working of this institution to you as representing the State of Oregon. Two years ago I had a similar duty to perform. In the report then presented, hopes were expressed that time would demonstrate the soundness of the plans of government and control adopted by this Board. The proof was to consist in an increasing number of students, supplied from those special classes of our citizens chiefly interested in Agriculture and the Mechanical Arts, in the visible improvement of the students of both sexes in their studies, deportment, and character, and in the increased influence of the College and Experiment Station on the people of the State.

The report of President Bloss, appended to this report, gives, in the opinion of this Board, satisfactory evidence of the widely extending influence for good now being exerted throughout Oregon by the State Agricultural College. The institution has lost whatever was local and restricted in its roll of students, who are now sent to us from all parts of the State. The bulletins sent out from the Experiment Station at frequent intervals have now a circulation of nearly five thousand copies. The farmers' institutes under the direction of the College are welcomed everywhere. The attendance at these pleasant meetings constantly increases, and lively interest is always shown in the papers and debates on the many and diverse topics affecting the farming community.

* * * * * * *

The year 1891, was one of steady growth and development under the Presidency of the late Prof. B. L. Arnold. To the high character and thorough scholarship of this gentleman the College owes much. His rule was just, kind, courteous; his habits those of constant industry and conscientiousness. The extent aud depth of his influence over his students were only demonstrated by his unexpected death in January, 1892.

THE IMPORTANT RELATIONS HELD BY THE PRESIDENT OF A COLLEGE TO THE INSTITUTION.

The Board of Regents felt to the full their responsibility in the choice of a successor. They recognized that as is the President, so will be the college which he governs. Not only are high personal character and wide and deep knowledge essential, but the President must be a ruler of men—full of tact, and experienced in the difficult art of government. In the case of the Agricultural College, moreover, especial technical knowledge is demanded. The direction of the Experimental Station calls for a man in sympathy with the special needs of the farmers in the transition state marked by the development of the orchard, fruit farm, and general farm, yielding many products from the wide wheat farms and stock ranches of the past decade. The Board took steps to make the impending selection very widely known. Their success was proved by the receipt of nearly forty applications from all parts of the Union. A careful scrutiny reduced the number of selected candidates to five. Still closer examination of the qualification of the selected candi-

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*Annual Report of the President of the Board of Regents of the State Agricultural College to the Governor of Oregon for the year ending June 30, 1892. Legislative Assembly, Seventeenth Regular Session, 1893. Published by authority. Salem, Oregon: Frank C. Baker, State Printer, 1893. Pp. 44.

dates was followed by the choice of Professor John M. Bloss, then of the Topeka Schools, an educator of long and varied experience, who had filled most important positions for many years both in Indiana and in Kansas, and who brought with him to Oregon both the cordial good wishes and the genuine regrets of all his former associates. The new President took charge of the College and Station in May last, very near the close of the college year.

The Board felt it to be very desirable that the new President should have all the time possible before the opening of the next college year to know and be known in all parts of the State, and to use such methods as he might approve for attracting students to the college. It is right at this point to notice the fact that the Board placed on Professor J. D. Letcher, as the senior professor, the temporary charge of the college in the sudden necessity consequent on Professor Arnold's death. The responsibility was at once assumed by Professor Letcher, although at that time he was suffering from depressing sickness, in which a less conscientious man might have readily found an excuse. The facts of growth and development which will be found to be detailed in President Bloss' report, appear to the Board to justify to the full the selection they made. I desire to emphasize our conviction that not in numbers alone, but rather in the raised tone, character, and attainments of the students, is to be found the proof that the President is the right man in the right place.

The announcement is made that the Supreme Court of the State, has confirmed the State of Oregon in its "unshared and undisputed control of the College and its possessions."

While it is a matter of great regret to the Board to have to appeal once again for further funds for building and furnishing purposes, yet the argument now comes with added force that it is the undoubted growth and development of the institution which demands it. To appeals for a stationary or retrograding school, a Legislature might turn a deaf ear. For this College, only now entering upon a full career of usefulness to the State and fed and maintained with yearly increasing funds by the munificence of the General Government, it seems to me that it would be hard to refuse any moderate and well considered amount needed for new buildings in which to utilize, for the benefit of the State, the Government appropriations. The full details of the sum which this Board desires to expend for the benefit and extension of the College are found in the report of President Bloss on the last page thereof. To these details I desire to call special and favorable attention.

THE LEGISLATURE TOLD OF THE NEED FOR MORE BUILDINGS.

One thing is sure: It is impossible for any institution to remain stationary. To endeavor to stand still is to retrograde. That is the exact condition of the State Agricultural College to-day. Its rooms are full to overflowing. The work-shops of the mechanical department cannot give room, nor does the present equipment in tools suffice for even the students we now have. There is not room in its chemical, zoölogical, and botanical laboratories for the student-work there on which their improvement depends, under the intelligent and modern method applied to them to-day. The horticultural department is without even any lecture or teaching-room at all, and badly needs other facilities. The agricultural department now overflows the barn and shed-room it has, and is unable, without further funds, to tile-drain and otherwise develop the farm, which is to be the best of object lessons to the farmers of Oregon as well as to the students. The department of photography is put away in a slip of a room, without the possibility of a skylight by means of which to print. The number of students has overgrown the desk and table-room which was thought adequate two years ago. The chief increase in numbers is in the college classes proper, not the preparatory department, which comes into comparison with the public schools. Even if the preparatory department were

cut off altogether, the application for building and furnishing funds would still have to be presented. But, this same preparatory department serves to open the doors of the College to some of the most eager and struggling students.

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With this account of the wide and most useful future now open before this College and Station, the Board must leave the matter to the wisdom and liberality of the Legislature of Oregon.

W. S. LADD,
President of the Board of Regents.

CORVALLIS, *January* 4, 1893.

FIRST REPORT BY THE NEW PRESIDENT OF THE COLLEGE.

CORVALLIS, OREGON, *December* 31, 1892.

Hon. William S. Ladd, President of the Board of Regents, State Agricultural College:

MY DEAR SIR: I herewith transmit to you, and through you to the Board of Regents, the following report on the purposes and needs of the State Agricultural College, together with statistics showing its enrollment for the past two years. The report also contains a summary of the work of this station for the time mentioned, and is placed over the signature of the several professors and instructors.

PURPOSES OF THE SCHOOL.

The State Agricultural College of Oregon has been organized under the National law for the establishment of such schools. It includes within its curriculum all those branches of study and lines of discipline contemplated in that Act. The following is a brief outline of its purposes and a statement of what has been done to carry out these purposes.

Neither the State nor the Nation can afford to establish and to sustain a system of education which does not have for its basal thought the making of better citizens of those who come directly under its influences. Better citizenship does not depend wholly, nor even primarily upon intellectual culture, because loyalty to both the State and the Nation, loyalty to duty, honesty of purpose, unflinching fidelity, personal purity, and willingness to submit to legal restraints, are each elements essential to the perpetuity of the State and the Nation. Hence an effort has been made in this institution to cultivate, by direct instruction in ethics, all the nobler traits of mind and heart, as well as to surround the student as far as possible by all those influences which lead to higher ideals of duty and respect of self.

It has been the purpose of the Faculty and the President of this institution to combine ethical teaching with the instruction in all the branches taught. Hence it is believed that every reasonable effort is being made to prepare the youth of this institution for better citizenship, thus justifying the State and Nation in their beneficence.

The intellectual culture contemplated in this College does not vary in quality from that obtained in other educational institutions in the State, nor should it.

THE TERM "EDUCATION" DEFINED.

Education involves information, yet it is not information. Education awakens the faculties of the mind to energetic action, but this is not education; it is only a means. Education involves the training of the faculties of the mind, and the rendering of these intellectual faculties submissive to the control of the will. It is the result of all these processes of training that terminates in education. Such training may be secured while pursuing the work laid out in the curriculum of the Agricultural College, as well as in the private college, the normal school, or the university.

THE AGRICULTURAL COLLEGE IS, BY THE NECESSITY OF ITS CREATION, A POLYTECHNIC SCHOOL.

By the law of its organization the Agricultural college has a special field of work assigned to it—a field which is covered only in the minor details by the work of any other State or private institution. When organized to fulfill its highest mission, it is a polytechnic school, where the scientific principles underlying the great business industries—agriculture, mechanic arts, and household economy—are taught in conjunction with military discipline and military science. Agriculture is here used in its broadest sense, and embraces all appertaining to the art of good husbandry, including horticulture, veterinary science, and all that relates to the proper rearing of animals and plants and their preservation from disease. Mechanical industries include all the forms of work in wood and metals, as well as the manufacture of machinery for the application or transmission of power. This is a broad field, and a proper investigation of these subjects as sciences and as arts, makes it necessary to study thoroughly several other branches of learning. The study of English must be pursued; first, that the constructive imagination of the student may be cultivated; second, that he may be able to comprehend the literature of the subjects studied; and, third, that he may be enabled to express accurately and intelligently the results of his researches, and thus become a valued member of society. For these reasons the study of English and training in the art of expressing thought has been made obligatory upon all students. An understanding of the science of agriculture includes a knowledge of the proper preparation of soils for the reception of a crop. Hence the student must understand how to secure the best mechanical condition of the soil, not only to cause the immediate disintegration of the tough and baked clayey soils by direct physical means, but he should understand how tile-drainage renders such soils permanently friable. The latter involves a knowledge of engineering and a study of the philosophy of tile-drainage and irrigation as well. To insure the best returns from the farm, the chemical properties of the soil must be known, as well as the chemical constituents of its products. To improve the impoverished soil, a knowledge of the needed fertilizer must be known. To feed stock successfully, the chemistry of food plants must be ascertained, and properly adapted to their needs. Thus if ten bushels of wheat contain only enough lime to make the shells of five dozen eggs, it alone would be an unprofitable food for poultry. If one hundred pounds of clover hay has more lime in it than one hundred bushels of wheat, it might be used as a valuable food where lime is needed. Hence agriculture necessarily involves a thorough knowledge of inorganic and organic chemistry. For this reason, the course in chemistry has been extended, and the pupils are required to do a large amount of work in the chemical laboratory. In this respect our plant, although limited in room, is made to accomodate about thirty students. Agriculture also involves a knowledge of the breeds of stock, as well as the means of securing the most rapid growth and the prevention of disease. Hence a knowledge of comparative anatomy and veterinary science is essential. But food plants are liable to be injured or destroyed by disease, or they may become the prey of insects. Hence the agriculturist and the horticulturist must have a knowledge of entomology and insecticides. Here again opens up a wide field for the investigation of the true scientist and agriculturist. The microscope and a knowledge of microscopy now become essential. This field is one that is ever widening with the growth of science, and is as yet comparatively untouched. Observers are needed upon every farm in order to overcome the ravages committed upon the growing crops. Every student of agriculture and household economy is required to study entomology in the laboratory, in order that a thorough acquaintance with the known pests to agriculture and horticulture may be acquired.

HOW LABORATORIES AID SCIENTIFIC INVESTIGATION.

Our laboratories in chemistry, physics, and along biölogical lines are small, not giving sufficient room for the students now engaged; they are, while the best in the Northwest, incomplete as compared with that of the best institutions. The rapid growth of the school shows that more room and a larger and more complete equipment is needed to meet the demands of our work. Laboratory work is essential to the successful study of all subjects, and it is the only method which can inspire the student to become a real investigator. Upon the number of educated investigators is dependent the rapid development and the material prosperity of the State. Horticulture, when studied from a scientific point of view, is not only ennobling to the mind, but is a subject of greatest profit to the State. With this subject, as with certain fields in agriculture, the science of botany is intimately related, and becomes in its proper study an important factor. The study of plant life, methods of growth, the means and the manner of decay, the plan of cell formation, the philosophy of circulation, the methods of repair, the processes of fertilization, are all inspiring subjects to the earnest student, and open up to him broad fields rich in thought. The philosophy of budding, grafting, transplanting, and methods of propagation have a high educative as well as esthetic value. The laboratory process is carried on in the study of this subject; hence all the pupils who study agriculture and household economy are required to learn the art of budding, grafting, methods of pruning, and caring for flowers, for testing the values of vegetable products and modes of culture. Here, as will be found in other departments, we have reached the limits of our quarters. There is not room for the proper instruction and work in our ever-growing classes.

WHAT THE THOROUGH STUDY OF MECHANICS COMPRISES.

The mechanical department covers a wide range of work and investigation. Here is laid the foundation upon which the work of the artist and the artisan and of those who conduct the great business industries must rest. This training consists of a college course of four years, and includes a thorough and more extended knowledge in physics and in mathematics than the other courses. Here is brought into use the students' knowledge of free-hand drawing. Here their knowledge of physics and calculus is applied in studying the machine and the laws producing motor powers. Here mechanical drawing is taught and applied in preparing the drawings from which work in wood and metal is fashioned. In this course, not only the study of the philosophy underlying mechanics is mastered, but the student is required to spend one hour each day at work in the shops. The first year is devoted to work in wood, in which the use of all the tools used in carpentry is brought into requisition, and all the forms of work in framing and carpentry are reproduced from blue prints of drawings which the pupils have been required to construct. The second year is devoted to work in the blacksmith shop. Here every form into which iron is wrought and every process with which the skilled smith must be acquainted, is repeated. The testing of all such work as to exactness of size and accuracy of form has as much educational value as the correct solution of a problem in algebra or geometry. The third year is devoted to vise and machine work. The fourth year is devoted to the manufacture of tools, and to the higher forms of work in the machine-shop. Some useful machinery, including a fifteen-light dynamo, is now under construction by this class.

HOW THIS KNOWLEDGE MAY BE APPLIED IN THE PRACTICAL LIFE OF THE FARMER.

When the student has completed this course of instruction, if he devotes his attention to farming, he is prepared, with the outlay of about forty dollars, to repair and to keep in order the machinery of the farm. He learns how to care

for and to manage machinery. This to-day is one of the most important problems to every farmer, and is no less useful than a knowledge of the sciences of agriculture. Especially is this true as to the value of the services of the farm laborer. In the mechanical department is laid the foundation for the thorough mastery of all great mechanical industries. Here are educated men who may readily become skilled in any of the great mechanical pursuits. Here are prepared men not only to be artisans, but to become managers of great business industries. They do not simply learn a trade as an apprentice, but they learn the philosophy of what they do as it never was taught to the apprentice in the most palmy days of apprenticeship. It is well known that the days of apprenticeship are past. Two things stand in its way: First, Labor Unions practically control the employment of apprentices by limiting the number; second, by the division of labor in all the great manufacturing industries, there is no necessity nor desire to teach all the parts of any great industry; it is more remunerative to the manager to hold the laborer to that kind of work which he can perform with the greatest skill. Hence the study of mechanical industries is essential to the State.

IMPORTANCE OF SCIENTIFIC TRAINING IN THE MANAGEMENT OF THE HOUSEHOLD.

The department of household economy and hygiene is an important factor in our college work. Here the young women spend an hour each day in studying the art and philosophy of household economies. Sewing, millinery, dress-making and fitting, and the chemistry of cooking, are among the subjects practically taught; while social etiquette and the laws of hygiene and the care of the sick are not neglected. The training in this department is exceedingly valuable, because neatness and correctness are required in all its steps. To the State, no more important work can be done than to cultivate those habits which should prevail in every household. Economic habits, cultured taste, and nobility of character are the elements which go far to make and to keep the home happy. The happy home is the prosperous home. Upon such homes rest the perpetuity of the Republic.

USEFULLNESS OF A KNOWLEDGE OF PHOTOGRAPY.

Two other departments have been added since the last report was made to the Legislature; photography and photo-gravure, and printing. In each, much interest has been manifested, and the classes are larger than our accommodations warrant. Photography is important to the student for its educational value in applying his knowledge of chemistry and physics, while for its esthetic culture it is invaluable. Photography is no longer to be regarded as a secret art, nor is a knowledge which is so valuable, and a means which adds so much to human happiness and pleasure, to be overlooked in a course of study. Aside from its educational value, it is almost a necessity in the scientific work of the station.

TYPE SETTING IS OF EDUCATIVE VALUE.

Many young men are practically unfitted, by nature or by accident, for work either on the farm or in the mechanical pursuits. For this class it was believed that printing would be a valuable line of work. It has not been restricted to that class, however. Young men and young women both have been admitted to this class of work. This is not only valuable as a trade, but it has within it a great educative value. The training in spelling, composition, punctuation, and in all the other lines of English is exceedingly valuable. The first class in printing was organized this year, and its progress has been very commendable.

LABORATORY PROCESSES.

That we learn to do by doing has become an axiom in educational literature. In the Agricultural College, practically, all the work is tested by the laboratory process.

In physics, chemistry, mechanics, drawing (freehand and mechanical), botany, zoölogy, physiology, surveying and engineering, English, household economy, and in all the agricultural and mechanical, and horticultural processes this method is fully carried out.

The President, then recites the value of military drill in the course, and states that Capt. C. H. Warren, of the U. S. Army, who had charge of this, had resigned and a new officer has been applied for to the U. S. authorities.

REQUIRED LABOR.

In this institution, which is in one sense an industrial school, each student is required to devote one hour each day to labor. The kind of labor depends upon the course which the student is pursuing. If he is in the agricultural course, then it includes all the kinds of labor which is done upon the farm or garden, thus putting into practice that which has been taught in the classes. He is required to make surveys for tile drainage as well as to take lessons in laying the tile; he sows the seed, notes the growth and development of the plants, and the fruitage; he is taught to graft, to bud, and to cultivate the tree or plant properly, as well as to prune and train it; and during the winter term he learns the art of carpentry and blacksmithing. If he is in the mechanical course, he learns the art and the philosophy of making all the forms of work in wood and metal, as was indicated above. If the student is pursuing the course in household economy, she is taught the art and science of sewing, dressmaking and fitting, canning, preserving and cooking. In addition to this, she is required to do work in household gardening, including grafting, budding, and flora-culture. If printing be the industry, then type-setting, proof-reading, press-work, etc., constitutes the labor.

Thus it will be seen that the work required of the student is along the line and in pursuance of the course which he has undertaken.

HOW THIS LABOR BECOMES OF VALUE TO THE STUDENT.

The reason for requiring work are the following

First—Because it is the best means of testing the work of the class room.

Second—Because of the educative value which comes from enforced accuracy and neatness.

Third—Because the knowledge thus gained enables the student to acquire any trade or vocation readily when he leaves the school.

Fourth—Because it stimulates within the student self-reliance and a respect for physical labor. The student who looks upon physical labor as beneath his dignity, or who would show disrespect for the laborer because he is a laborer, is wholly unfitted for training in this institution.

Fifth—Because physical labor, and the practical knowledge of how to perform it, inspires the student with higher ideals of life and best fits him on graduation to compete with skilled labor.

Sixth—Because it enables him to become a more useful member of society.

STATISTICS.

The following tables of stastistics show the enrollment of the school during the year 1891-2, and the first term of 1892-3:

	No. enrolled for the year 1891-2.	No. enrolled for the first term 1892-3.
Number of males enrolled	130	161
Number of females enrolled	78	94
Total enrolled	208	255
Classified by departments.		
College department	122	181
Preparatory department	86	71
Total	208	255
Classified by years of work.		
Preparatory department	86	74
First year	63	121
Second year	28	36
Third year	19	14
Fourth year	9	8
Post graduates	3	2
Total	208	255
Classified by courses of study.		
Preparatory department, agricultural and household economy	86	74
Agricultural course	29	39
Mechanical course	33	60
Household economy	48	66
Literary course	6	....
Scientific course	8	5
Post graduate course	3	2
Total	208	255

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NEEDS OF THE STATE AGRICULTURAL COLLEGE.

An institution of learning, like any other undertaking, if successful, must be the outgrowth of some real necessity; and the lines of its growth must be in harmony with its environment. That the State Agricultural College has grown, and that it is in harmony with its environments, cannot be doubted after a careful investigation of its history, as exhibited by the statistics contained in this report. The reörganization of this college in 1888 marks a mile-stone in its history. It then began to assume its proper sphere, and to come into harmony with the purpose of its existence.

The plans adopted in its organization demanded time for their development. It was necessary that the class should commence at the very beginning, and pass step by step through all the processes to an agricultural and industrial education before the method adopted could be fully tested and the necessary adjustments made. The period of readjustment from a literary and classical school to an agricultural, mechanical, and industrial school has been almost completed. In June next, the first students will graduate from the mechanical course. The reörganization referred to above was an internal reörganization, the reärranging of courses of study, the organization of new departments, and the gradual introduction of industrial work. This not only demanded time for its execution, but required the greatest care to prevent violent reäctions while changing from an institution of one character to that of another. That period is, however, wholly passed.

NEW BUILDINGS NEEDED FOR THE COLLEGE AND FOR THE EXPERIMENT STATION.

In addition to this change in the character of work to be done, a still greater problem has constantly presented itself—the organization of what may be termed the externals of the college. Buildings adapted to the new purposes of the institution must be erected, laboratories must be fitted up, cabinets, collected, machinery provided for carrying on the industrial work, green-houses constructed and the contents gathered, silos built, stock for experimenting secured, plants, shrubs, trees, grasses, and grains provided before any work in experimentation could be undertaken. This work of organizing the several departments went on simultaneously with the reconstruction of the internal work of the institution. It requires many buildings and much expensive apparatus to carry into effective operation such a school. The National Government practically furnishes the means for carrying on the internal work of the school, and has wisely left it to the State to furnish the plant and the means for their application. Only a very small part of the magnificent endowment which comes from the General Government can be used for the erection of buildings, the fitting up of laboratories, and securing the apparatus necessary for the school. These equipments the State has furnished in the past as rapidly possibly as the needs of the school required; but the institution has outgrown its earlier necessities, and now rightly makes far greater demands upon the State. The period of experiment is passed, and there is now every evidence that the school is needed and demanded by the people. That it is in happy relationship with its environments is evidenced in its growth since 1888, as will be seen by the following table:

STATISTICS OF ATTENDANCE FOR FIVE YEARS.

Year.	Preparatory.	First year.	Second year.	Third year.	Fourth year.	Post graduate.	Total.
1888-89	36	33	14	14	0	0	99
1889-90	67	55	17	6	0	6	151
1890-91	76	83	24	15	0	3	201
1891-92	86	63	28	19	9	3	208
1892 to January, 1893	74	121	36	14	8	2	255

The above shows a constant growth all through this period of reconstruction and reädaption. From ninty-nine students in 1888, it has now reached two hundred and fifty-five, a gain of almost 260 %; while it will also be observed that the College Department has increased almost 300 %, and the preparatory only 200 %. These are evidences of a healthful growth; and as the character and purposes of the school become better known throughout the State, its growth will not be less marked. In 1888, the College had representatives from only eight counties; in 1891, from fifteen counties; and, at present, twenty-five of the thirty-one counties are represented.

The transition of this College from the condition of a small denominational college favored with the annual income arising from the U. S. Land Grant, to that of a recognized State Institution, wholly under the direct control of the State, and looking to the State for the means of its development; in addition to the U. S. Grants,—has been so recent, and is, in point of fact, so revolutionary, as to afford a very interesting study.

This is, doubtless, one of the indirect results of the passing of the

Hatch act establishing "Agricultural Experiment Stations" in the several States; which, when utilized by uniting the Land Grant Fund and the Hatch Act Fund, and placing the two institutions in close relations, under a single executive, makes possible the building up of one strong institution, which it is worth while for the State to encourage and support. It results that, owing to these triple sources of income to be expended under the supervision of the State, the enlargement of the educational plant, in buildings and apparatus, and the consequent increase of the teaching force, can be undertaken on a scale worthy the highest educational Institutions of the State.

The 255 students in attendance are divided among the departments as follows:

Agricultural department	39
Mechanical department	69
Household economy	66
Bachelor of Science	7
Preparatory department	74
Total	255

The President, proceeds to state in detail the needs of the several buildings and departments. That of the Mechanical department as follows:

The mechanical department is now more than crowded with students in the mechanical course, and is wholly inadequate to meet the demands for training the agricultural students in the arts of woodwork and blacksmithing during the winter term. This is too essential a part of our work to be neglected. The building ought to be greatly enlarged, and the machinery duplicated. This department cannot afford to be crippled in its usefulness. Now but little attention can be given to electrical engineering; yet this is of the utmost importance to the State. Electrical plants are being everywhere established throughout the State. It is only a question whether Oregon shall import electrical engineers from abroad to develop and to utilize the power of her water-course, now almost wholly unused, or whether the Oregon boy shall be given a chance. It is only a question of time when our rivers will furnish not only all the light for our cities and towns, but the motor-power of all our great industries. This department should be established at once, in order to keep pace with our sister States and the progress of civilization.

He asks, for additions to buildings and to departments, an appropriation of $49,900.00 in all.

For the Experiment Station	$20,000
For the Mechanical department	15,000
For the Horticultural department	1,850
For the Agricultural department	6,000
For the College	7,050

As already stated the total attendance of students is 255; of these 94 are girls.

The Faculty numbers 14 Professors, Instructors, etc., John M. Bloss, is the President.

The Pennsylvania State College, Formerly Known as The Agricultural College of Pennsylvania.

SITUATION.

The Pennsylvania State College "is situated in the village of State College, Centre county, nearly twelve miles southwest of Bellefonte, and about equi-distant from the extreme parts of the State. Its position, in the midst of a broad, rolling valley, with Muncy mountain on the north, Tussey mountain on the south, and Nittany on the east, secures a varied and beautiful landscape and a healthful climate.

A special act forbids the sale of intoxicating drinks within two miles of the College, and all its surroundings are exceptionally free from demoralizing influences, and from temptations to extravagance.

The Building.—The main College building is a plain and substantial structure of magnesian limestone, standing on a pleasant elevation, and is two hundred and forty feet in length, eighty feet in average breadth, and five stories in height, exclusive of attic and basement. It contains the public rooms—such as chapel, library, armory, cabinets, laboratories, society halls, and class-rooms—and a large number of dormitories. The building is heated throughout with steam, one or more upright radiators being placed in every room, hall, and passage-way, and is furnished on every story with an inexhaustible supply of pure water from an artesian well. The sewerage system is well devised and frequently inspected, and the unusual exemption of our students from every form of sickness justifies the statement that the sanitary condition of the building is very nearly perfect.

Campus and Farm.—The tract of land on which the building stands contains nearly three hundred acres. Of this, about fifty acres in the immediate vicinity of the building constitute the campus, and furnish recreation grounds, sites for the professors' houses, and other needful buildings, &c. The campus contains, at present, several of these residences of professors, and is tastefully laid out and adorned with trees, shrubbery, flower-gardens, and walks.

The College farm consists of two hundred and forty acres, forty of which are woodland. The remainder, except so much as is occupied by farm-buildings, orchard, and vineyard, is worked under a system of rotation of crops, in five divisions of thirty to forty acres each. The soil is limestone, with a large admixture of flint, and is admirably adapted to the production of the various grains and grasses grown in this region. The farm-buildings include dwelling-houses, a large and excellent over-shot barn—with double threshing-floor, threshing-house, corn-cribs, root-house, and stabling—a hog-pen, a slaughter-house, a tool-house, &c. An orchard of about fourteen acres—chiefly of apples—and a vineyard of five hundred vines are in good bearing condition.

The greater part of the labor upon the farm, orchard, vineyard, and campus is done by paid laborers, but the professors in charge of instruction in Agriculture and Horticulture make use of all parts of the College grounds for their purposes, and require of each student under their charge as much labor in each place as they deem needful for proper practical training. [Catalogue for 1886–7.]

Historical Statements.

This Institution, was first founded as the "Farmers High School of Pennsylvania," under the patronage of the State Agricultural Society, and the County Agricultural Societies, whose delegates elected its Board of Trustees.

It was chartered by the Legislature, and approved by the Governor,

as early as April 13th, 1854. A subsequent act of Incorporation, naming the Trustees and more definite in its provisions than the above act which it repealed, was approved February 22nd, 1855; though the school was not opened for pupils till February, 1859.

It was designated as a Manual Labor College, each student working three hours a day. The course of study was to be as thorough as that of other colleges, but was not to include the classical languages. A large farm of 400 acres and money for building, etc., was contributed by the agricultural societies, and by individual friends of the enterprise. However, after an expenditure of $120,000, the school was in danger of collapse from want of sufficient funds to complete the buildings. A successful appeal having been made to the Legislature for State aid, the school was authorized May 1st, 1862, to take the name of The Agricultural College of Pennsylvania. On April 1st, 1863, the Legislature designated it to receive the income of the National Land Grant for Agricultural and Mechanical Colleges. Subsequently, on the 26th day of January 1874, in response to the petition of the Trustees, the name of the College was again changed to that of the Pennsylvania State College. The general scope of the purposes of the Institution having been of necessity greatly enlarged in obedience to the liberal provisions in the the Land Grant Bill, for the comprehensive education which that law requires to be given in the new "Colleges of Agriculture and The Mechanic Arts."

A Notable Report by The First President of the Institution.

The late Dr. Evan Pugh, PH. D., F. C. S., a gentleman of distinguished reputation who had given much attention to the subject of scientific Agriculture and Industrial Education, having passed some six years in Europe, where he carefully examined the existing institutions, was chosen as principal of the school; a position he retained till his sudden and lamented decease, in April, 1864.—Subsequent to the passage of the National Land Grant law, a report by Dr. Pugh,* upon Industrial Colleges, was addressed to the Board of Trustees of the institution, convened at the State Capitol, in January, 1864. This Report, evidently designed for use in convincing the Legislature of the propriety of designating the State College as the beneficiary of the National Land Grant, was an able paper. An interesting his-

* A Report upon a plan for the organization of Colleges for Agriculture and the Mechanic Arts, with especial reference to the organization of the Agricultural College of Pennsylvania.

In view of the endowment of this institution by the land scrip fund, donated by Congress to the State of Pennsylvania.

Addressed to the Board of Trustees of the Agricultural College of Pennsylvania, Convened at Harrisburg, Jan 6, 1864. By Dr. E. Pugh, President of the Faculty. Harrisburg, Singerly & Myers. Printers, Pp. 35. 1864.

torical fact appears in the claim, emphatically made, that, to the long continued efforts of the Trustees, and friends of the Pennsylvania State College, was due the inception and final passage of the law of Congress.*

In this report, after showing by means of several statistical tables the number of professors, the pecuniary resources, and annual expenditures of the leading colleges in the United States; he proceeds to set forth, on a similar basis, the pecuniary and other needs of a scientific college of the first rank, such as should be established. The comprehensive breadth of the views expressed in regard to the province of education in its bearing on the application of Science to Industry, being no less true in relation to the application of Art to Industry, the following passages are here quoted.

RESOURCES REQUIRED TO SUSTAIN AGRICULTURAL AND INDUSTRIAL COLLEGES.

Having briefly examined the resources expended in sustaining the literary Colleges of our country, we are prepared to consider what may be required to found and sustain Industrial Colleges.

The first question that arises, in this consideration, relates to whether it is desirable that Industrial Colleges should be elevated to the highest possible educational standard, with the greatest range of scientific and practical subjects, within the scope of their teaching, in the class room; or whether they should be Institutions of an inferior grade, with contracted limits to the variety and extent of the subjects taught in them. This question has already been settled in this State, by the action of the State Legislature, in conjunction with the citizens of the State, in appropriating and subscribing money to found the Agricultural College of Pennsylvania, upon a basis capable of being successfully carried out, only upon a large scale, with an efficient course of instruction. But as the extent and character of the course of instruction might still seem open to discussion, the attention of the Board is respectfully invited to its consideration.

THE COMPREHENSIVE CHARACTER OF THE EDUCATION DEMANDED.

FIRST.—A complete system of industrial education must afford the means of making known to students all that can be known of the Principles and Laws, according to which the industrial operations of life are regulated. If the system does not do this, it fails to afford the student all that he may wish to know, and obliges him to look beyond it, to other systems, to complete his education, in the *very sphere* to which the Industrial College is especially devoted. If he must look beyond it for the *highest kinds* of knowledge it claims to teach, he will lose his respect for it, and ultimately seek elementary instruction in the same source to which he is obliged to go for his profounder studies, and thus industrial education is left to obtuse minds, without aspiration for thoroughness, and the whole system falls to the ground disgraced.

Again.—By no system of education can elementary principles be perfectly taught without there being somewhere in the system a clear understanding of all that is known in the advanced studies of these principles. The purely practical Mathematics of elementary instruction would be a contemptible part of education, were

*See pages, 11–30 and 32–34 of Dr. Pughs' Report. See, also, account of the efforts made by Rev. Dr. Amos Brown, and by Dr. Pugh, to secure the passage of the act by Congress, in Appendix Z of this Report.

it not that they rest upon sublime truths that are demonstrated and understood in the higher grades of mathematical study.

SECOND.—A system of education which embraces all that can be known of the Principles and Laws, according to which the industrial operations of life are regulated, must be a very extensive system. This follows from the fact that the industrial operations of life embrace the *entire range* of human industry, and almost the entire range of human thought. The fundamental difference between man as a savage and man as an enlightened being, consists in the *difference in the extent of his industrial operations.* The characteristic peculiarities of the present age, by which it is distinguished from preceding ages, consists in its more extended industrial operations. The Principles and Laws which lie at the basis of all industrial operations, must, therefore, be at the basis of human progress, and the study of them as important and as extensive as is human progress itself.

THIRD.—This extensive system of industrial education must be of a *scientific character.* The industrial operations of life are carried on through the instrumentality of Matter and the laws which govern it. They extend to Matter in all conceivable forms, and in all known places, and for the systematic and intelligent consideration of Matter under all these circumstances, we must call to our aid the entire range of the Natural and Physical Sciences.

FOURTH.—A system of scientific education, embracing the entire range of the Natural and Physical Sciences, can only be carried out efficiently upon a large and liberal plan, supported by endowments equal to those of the best educational Colleges in the country. This is proven, no less, by a consideration of the subjects to be taught, than by the fact that no American College, however well endowed, has yet succeeded in establishing a complete system of scientific education, and even the European Universities, with which the President of Harvard College says that University dare not court comparison, do not pretend yet to have, at any one of them, a complete course of scientific instruction.

LIBERAL ENDOWMENTS BY THE STATE AMPLY JUSTIFIED.

Such then will be the magnitude of the demands of industrial education in Industrial Colleges. We cannot expect to meet them in the present generation, but with their colossal proportions before us, let no man say that endowments, equal to half of those of our best literary Colleges, are too much for our industrial Colleges. But rather let their endowments be doubled and trebled, that America may become in industrial education, as she already is in the industrial operations of civil and military life, the *first country* in the world—that the nations of Europe may be taught in our industrial Colleges, as they now are taught by the industrial operations of stupendous military system.

One other consideration—while the expenses of an industrial system of education are thus great, *those for whom that education is designed* are generally persons of *small income.* The education they receive is calculated to benefit *society in general more especially* than themselves in particular. It does not, as a professional education often does, elevate them from an humble position in life to lucrative posts, in which they can retail out to the community the knowledge they have acquired; but enables them more effectually to perform the several duties of their industrial operations, and thus leads to an ultimate improvement of all those means by which, as before remarked, civilized man is distinguished from the savage; hence not only the necessity, but the justice to the industrial classes, of endowing industrial colleges.

In Dr. Pugh's plan for the organization of this scientific college, he shows that he was fully awake to the importance of a knowledge of Drawing, and to the evil results arising from the neglect of this study, in the American system of Education.

The following is his statement as to the requisites to be possessed by the instructors under whom technical drawing will fall. In his survey of the 29 Professors, assistant professors, and other officers he enumerates, he places these instructors first, as follows:

PROFESSORS AND ASSISTANTS REQUIRED.

1st. *A Professor of pure Mathematics and the higher Mechanics and Astronomy.*—A man capable of reading the works of Newton, Laplace and Pierce on Mathematics and Mechanics, and who could teach Descriptive Geometry, Perspective and Drawing. A serious fault with American teachers of mathematics, is an inability to give geometrical and stereometrical shape to their mathematical ideas, a consequence of their knowledge of drawing not having kept pace with their study of mathematical analysis, and this again is the result of the great neglect of drawing throughout our whole educational system, from the common school to the university. Every Professor of pure or applied mathematics in an industrial college, should be free from this source of inefficiency. This Professor should have one assistant, to take charge of the elementary classes.

2d. *Professor of Civil Engineering and Applied Mathematics.*—A man familiar with all the details of Civil Engineering, Architecture, mechanical Drawing, Topography, map-making, &c., so that he could not only teach the students the mathematical demonstrations of the class-room, but could make them good practical engineers, capable of delineating with accuracy the topography of a Country, the route of a Railroad, or the construction of an Edifice. He should have one assistant, who should be a good draftsman, and who could show the student how to work up the details of a survey. * * *

President Pugh, proceeds with a like description of the requisite qualifications of the other needed professors, and gives an elaborate statement of the proposed courses of instruction.

The college buildings, as already shown by the extract from the catalogue of 1886–'87, given at the beginning of this account, are surrounded by ample grounds reserved as a campus from the original 400 acres.

The endowment consists of a state fund of $500,000, on which the state pays 6 per cent interest. This represents the amount accruing to the state from the sale of lands under the United States land grant law. The actual amount received from the sale of land scrip, was $439,186.80; which the state increased to $500,000.

There were, until 1887, three experimental farms of 100 acres each. From the catalogue of 1881–'82, it appears that there are two general and four technical courses. A general science course and a general classical course; the two first years of each of these courses are so arranged that a student can enter either of the Technical courses in Junior Year.

The Technical courses are of two years each; and are in Agriculture; Natural History; Chemistry and Physics; and Civil Engineering.

A certain portion of time is set apart for exercise in technical training such as Military Drill, actual surveying in the field, etc.,

these are called "Practicums," some of them are only taken in special courses, others are common to all the courses; among the latter is "Drawing, free-hand and Mechanical;—needed by individuals in all employments and professions." On the general subject of this practicum in Drawing the catalogue of 1880–'81 says:

> Drawing.—The practical course in this branch is not demanded chiefly for the higher purposes of art, nor, as in some manufacturing districts of England and France, for the production of elaborate models and designs, to be subsequently applied by the silversmith, or the carver in wood, by the printer of paper-hangings, or the weaver. The ability to produce these designs is not recognized as one of the every-day needs of our citizens, and so it must for the present be gained at some special school of art. As, however, almost every one needs, at some time, to execute an intelligible draught of some object, our course seeks to enable every pupil to do this. The course consists of two parts: Free hand-drawing from copies in flat outline, which, while giving freedom of movement and speed of execution, trains the eye to recognize beautiful forms, and the hand to produce them; and mechanical drawing, which secures precision.

A Preparatory Department with courses of two years, is connected with the College. Pupils are here prepared to enter the College courses in sciences and the classics. In both of these preparatory courses, and in each term of each year, great attention is given to drawing.

This has become a prominent feature in the work of the Department, and is of very practical importance to the pupil. It prepares him for successful work, should he select a technical course, and is eminently useful in any vocation of life. "Warren's Industrial Science Drawing" is used. Part 1. the first, and Part 2, the second year.

In the College, drawing is taught in both courses in each term of Freshman year.

In the department of Civil Engineering "during the Junior and Senior years, the course comprises mechanical and engineering drawing, copying from the flat and from models, topographical sketches and maps, isometric and plane projections, plotting surveys and triangulations, lettering, map drawing, coloring and shading."—The catalogue for 1882–'83, shows a total attendance of 148; of these 55 are in first year, and 30 in second year of the Preparatory Department, and 47 in the four College classes; the residue are under the head of Special Students, and Resident Graduates.—

Certain criticisms having been expressed concerning the management of the College, and the charge,—a somewhat common one against this class of institutions of higher learning,—having been made that it failed to turn out practical farmers; the Trustees addressed a memorial to the Legislature, requesting the appointment by that body of a Committee, to thoroughly "investigate the affairs of the said College."

Such a committee was therefore appointed, which in due time

reported to the Legislature. From this report,* which was in all respects most gratifying to the friends of the college, the following extracts, showing the condition of the Institution, are quoted.—

The resolution was approved by Governor Hoyt, April 28th. 1881.

The Committee Organise.

At the first meeting of the committee, an organization was affected by the election of Hon. C. T. Alexander, chairman, and the Hon. George W. Hall, secretary. In order to facilitate the inquiries of the committee, the duty of taking testimony was intrusted to a sub-committee, consisting of Messrs. Mylin and Newmyer, with Alexander, chairman of the general committee of the Senate, and Messrs. Roberts and Hall of the House of Representatives.

The said committee, having pursued their investigations, have made to us the accompanying report, which meets with our concurrence and indorsements. We herewith present the same as part of our report, with an appendix embracing the acts of Congress and acts of the Legislature relating to the State College.

EVAN HOLBEN,	C. T. ALEXANDER, *Chairman.*
WM. B. ROBERTS,	
ALFRED SLACK,	GEO. W. HALL, *Secretary.*
JAMES MILHAM,	AMOS H. MYLIN,
A. WILSON NORRIS,	JNO. C. NEWMYER.

Report by Sub Committee.

To the general committee authorized to investigate the affairs of the Pennsylvania State College:

The sub-committee created by the general committee appointed under the concurrent resolution of the Legislature to investigate the affairs of the Pennsylvania State College, approved April 28, anno Domini 1881, respectfully report:

This sub-committee held numerous sessions at Harrisburg, West Grove, Chester county, at Philadelphia, at the State College, at the experimental farm in Indiana county, and at Bellefonte.

They sought by advertisements in the newspapers, by public invitations at their sittings, and by diligent personal inquiries, to bring before them every person who had or was supposed by himself or others to have any facts, opinions, or criticisms to offer which could throw light upon the subject matter of the inquiry, and lead the committee and the General Assembly to an impartial and satisfactory understanding of the real merits of the questions involved.

And in justice to themselves, in this connection, the committee feel bound to say that if any facts bearing upon the matter have not been brought to their attention, it has not been for lack of diligent effort on their part, nor because the doors of the investigation were not thrown sufficiently wide open to admit every comer. The resolution inviting communications to the college, was as follows:

"*Resolved*, That all persons who have any complaints or allegations to make against the management of the Pennsylvania State College, be invited to forward to the committee at Harrisburg, on or before March 20, 1882, any statement in writing they desire to make."

This resolution was given publicity through the agency of the Associated Press,

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*"Report of the Committee of the General Assembly appointed, at the Request of the Board of Trustees, to Investigate the affairs of the Pennsylvania State College, Under a joint resolution approved April 28, 1881. with the Laws and Decrees of Court relating to said College. Harrisburg: Lane S. Hart. Printer and Binder. 1883. Pp 34."

and besides this general invitation, subpœnas were issued to every person who was named to the committee as possessing information or facts likely to throw light upon the investigation, and notices of the sittings of the committee were published in the local papers.

The general field of inquiry was laid out under the following resolution, adopted at the first meeting of the sub-committee, at Harrisburg, January 17, 1882:

"*Resolved*, That in order to facilitate the labors of the committee appointed under the recited resolutions the committee proceed in the investigation in the manner following:

"*First.* To inquire whether the present management of the college is in compliance with the requirements of the act of Congress of July 2, 1862, and the several acts of the General Assembly of Pennsylvania in relation thereto.

"*Secondly.* To examine into the accounts of the said college to discover whether or not the interest derived from the fund realized from the sale of the land script fund has been duly expended in accordance with the requirements of the said act of Congress above recited.

"*Thirdly.* To inquire how the several appropriations made by the several acts of the Legislature of Pennsylvania to said college have been expended.

"*Fourthly.* To examine into all the funds received by said college, whether from individuals' contributions or receipts of students, and ascertain if they have been honestly appropriated and accounted for.

"*Fifthly.* To examine the experimental farms, and ascertain the amount of income derived therefrom, and of funds appropriated to each out of the general fund, their usefulness as such, and whether the funds appropriated to each have been honestly appropriated or expended."

The investigation thus outlined covers a very extensive field, and while some portion of the testimony offered to your committee was irrelevant and inconclusive, they believe they have embraced in their inquiry every important phase of the subject; and it is due to the authorities of the college to say not only that they have placed before the committee every document or other source of information within their control, but especially that the careful and business-like manner in which the accounts of the college have been kept greatly facilitated our inquiries.

The Educational Department.

Adopting, for convenience, the order of investigation suggested by the resolution quoted above, the first branch of our inquiry is, whether the present management of the college is in compliance with the requirement of Congress and the Legislature of this State in relation thereto. For purposes of reference, these acts are given in full in the appendix to this report, but the sections most strictly pertinent to this investigation are here quoted, as follows:

1. Act of Congress, approved July 2, 1862:

"Section 4. *And be it further enacted*, That all moneys derived from the sale of the lands aforesaid by the States to which the lands are apportioned, and from the sales of land scrip hereinbefore provided for, shall be invested in stocks of the United States, or of the States, or some other safe stocks, yielding not less than five per centum upon the par value of said stocks, and that the moneys so invested shall constitute a perpetual fund, the capital of which shall remain forever undiminished, (except so far as may be provided in section fifth of this act,) and the interest of which shall be inviolably appropriated by each State, which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal and

practical education of the industrial classes in the several pursuits and professions in life."

2. Act of the Legislature of Pennsylvania, approved April 1, 1863:

"SECTION 1. *Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met, and it is hereby enacted by the authority of the same,* That the act of Congress of the United States, passed the second day of July, one thousand eight hundred and sixty-two, entitled 'An act donating lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts,' be and the same is hereby accepted by the State of Pennsylvania, with all its provisions and conditions, and the faith of the State is hereby pledged to carry the same into effect." * * *

"SECTION 4. That, until otherwise ordered by the Legislature of Pennsylvania, the annual interest accruing from any investment of the funds acquired under the said act of Congress is hereby appropriated, and the said commissioners are directed to pay the same to the Agricultural College of Pennsylvania for the endowment, support, and maintenance of said institution, which college is now in full and successful operation, and where the leading object is, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts."

THIS ACT OF CONGRESS INCLUSIVE, AND NOT EXCLUSIVE.

It will at once be seen that the language of the act of Congress is sufficiently comprehensive to embrace every department of instruction, so far at least as not to exclude any branch of study from the institutions for which it makes provision. The controlling requirements of the act are: (1.) That a college shall be established. (2.) That its course of instruction shall include "military tactics." (3.) That it shall not exclude classical and scientific studies in general. (4.) That it shall aim to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life; and that, to this end, (5,) its leading object shall be "to teach such branches of learning as are related to agriculture and the mechanic arts."

By section one, of the the act of April 1, 1863, the State of Pennsylvania accepted the above-quoted act of Congress, "with all its provisions and conditions;" and as if to give its acceptance the highest possible sanction, added, "the faith of the State is hereby pledged to carry the same into effect." By section four of the act, the interest of the funds thus acquired under the said act of Congress was appropriated to the endowment, support and maintenance of the Agricultural College of Pennsylvania, on the express ground that it was already in operation, and so organized as to fulfill the requirement of the United States laws. Neither this nor any subsequent laws of the State made any modification of, or addition to, the requirements of the law of Congress, except as to the maintenance of three experimental farms, a subject that will be considered later. In order to ascertain whether the management of the State College complies with the requirement of these several laws, the committee made a careful examination of its courses of study and its methods of work, both as they now exist and as they have been in operation since the passage of the laws referred to.

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THE COURSES OF STUDY.

The committee find that the courses of study have, from time to time, been changed to meet the changing requirements of law or of public opinion; but, in its earlier years, the subject of agriculture, both theoretical and applied, always held a prominent place, while other subjects were included in the interest of a broader culture. We find, for example, the earliest printed courses of study provide

instruction in political and social, mental and moral science, astronomy, the higher mathematics, and other advanced branches of learning. The courses of study now in full operation are by far more extended and complete than at any previous period of the history of the college, and seem to comply, in the fullest sense, with the requirements of the laws of Congress and of this State. They include two general courses: One in general science, the other in the ancient classics; and four technical courses, viz: Agriculture, chemistry and physics, natural history, and civil engineering.

These courses cover a period of four years each, and, in addition, the college provides for the students who are unable for any reason to take a full course, a short special course of two years in agriculture, and a similar course in chemistry. Special students are also admitted for such length of time, and in such branches of study as they may elect, and be qualified to pursue. Military tactics are regularly taught, and all students, unless excused on account of physical disability or conscientious scruples, are required to drill. A course of farmers' lectures are delivered every year, which are free to the public. In connection with the usual studies of the class-room, we find that there is carried on a very extensive and progressive system of practical training in the application of knowledge, which, for extent and thoroughness, is equaled by few, if any institutions, of which we have information. The student in agriculture, for example, goes into the laboratory until he becomes a well-trained analyst, and into the field and barn to observe processes or to conduct investigations. The student in horticulture works in the gardens and vineyards. The student in mechanic arts goes into the shop, and is trained in the use of tools, as well as the principles of mechanics. The student in civil engineering acquires a knowledge of the instruments and the methods of his profession by actual work in the field; and similarly, in every department that admits of it, subjects are taught with constant reference to their practical application in the various industries of life.

THE MANUAL LABOR EXPERIMENT ABANDONED.

When the institution was first opened to students, a considerable amount of manual labor was required of all. This system was abandoned after a trial of several years, and the practical work now required is regarded as educational, rather than a matter of manual labor, though it evidently serves the two important ends of giving physical exercise and skill in manipulation. Whether the abandonment of compulsory manual labor was wise or unwise, the committee did not feel called upon to decide. As it is not required by any existing law of the United States or of this State, it would seem to be a matter wholly within the discretion of the trustees.

But, except in this particular, (about which there may exist natural differences of opinion,) we are compelled to say, in simple accordance with the facts as we find them, that the State college is furnishing a liberal and practical education for the industrial classes, and that its leading object is to teach such branches of learning as are related to agriculture and the mechanic arts. The chemical laboratories especially are in a most admirable condition of completeness and efficiency. The physical laboratory has a fine (though still inadequate) collection of the most approved apparatus of instruction; and the other departments of instruction relating directly to the industries of life, such as civil engineering, mechanic arts, &c., have received from the trustees small annual appropriations which have equipped them fairly for the requirements of ordinary teaching. There is great need, however, in all these departments, and in the library, for a large immediate outlay which the means at the command of the trustees does not enable them to make. Of the twelve (12) professors and assistants now constituting the teaching force in the college departments, only two give instruction in the classics; one of them, also, has charge of English literature, and other branches which necessarily enter into every course

of liberal education. In the same connection it should be noted that the appropriations made by the trustees for the purchase of apparatus and appliances for the several class-rooms have been almost exclusively for the industrial departments. Out of the appropriations of this kind, between the years 1866 and 1881, aggregating nearly six thousand, ($6,000,) less than one hundred dollars was given to the classical department, and that was for the purchase of maps.

The Committee further extol the character and behavior of the students. The Financial management is next considered at length, with the following result, as expressed in the final sentence of that part of the report:

The details are given in full in the accompanying papers, and we believe that no inpartial mind, on examining them, can fail to reach the same conclusion, that the financial trusts of the institution have been honestly and judiciously administered.

The Experimental farms are then described and the sale of two outlying ones suggested, and, in their place, the establishment of an experiment station is recommended. They conclude this part of the report thus:

If, as the course of legislation indicates, it is to be a part of the established policy of the State to lend its aid to the advancement of agricultural knowledge and practice, it would seem to be the dictate of sound policy to concentrate its experiments and efforts, both in the interest of economy, efficiency, and ease of control. The State College has already in use a large part of the appliances and equipment necessary for the successful maintenance of an experiment station, and is now doing a larger amount of valuable work in that direction than at any previous period of its history, and is now publishing its results in a series of popular bulletins.

As, in summing up, several topics of general interest in regard to these special Institutions are considered by the Committee, this closing part of this report is here given in full.

Conclusions and Recommendations.

The fact remains, notwithstanding the condition of things above stated, that the college for a long time has been subject to an amount of public criticism, which has resulted in a wide-spread distrust, if not hostility, towards it, and the committee have constantly directed their inquiries with a view to ascertaining its grounds, and, if possible, the proper remedy for it. Their conclusions have been presented, in part, in former pages of this report. But a few other points require further notice. It is obvious to us, in the first place, that much, if not most, of the feeling referred to, grew out of a condition of things which no longer exist. When the college was founded, several attempts had been made, in various parts of the country, to establish schools or colleges for instruction in agriculture, but not one of them had been successful. Many citizens of Pennsylvania, nevertheless, had hopes that the same experiment here would result differently; and many of them contributed liberally of their time and means to promote it. The enthusiasm of the few easily communicated itself to the many, and the public mind became possessed of vague and extravagant expectations as to what such an institution might be expected to accomplish. It seemed to be thought that a few months of "schooling" in an agricultural institution would convert boys who lacked the elements of a sound English education into skilled and scientific farmers. Such expectations were foredoomed to disappointment. The successful farmer must bring to the practice of his art obser-

vation, insight, judgment, and skill, which can come only from extended experience; and on the other hand, the student who desires to become familiar with the sciences on which agriculture rests, must pursue a long and thorough course of training.

Difficulties Connected With Manual Labor Colleges.

The college soon found that, while many were willing to come to it, and contribute their labor for a time in compensation for their education, few came to pursue the necessary course of higher instruction. It was also believed at the outset that the labor of students could be so employed as to make it remunerative, and the total charge per year for all expenses of attendance was placed at the low figure of one hundred dollars. It was soon found, however, that it was impossible to organize the labor of any considerable number of students on a limited number of acres in such a way as to avoid serious loss. This would be true even in skilled labor, much more the labor of untrained boys. The institution ran rapidly and largely into debt, and the trustees were soon compelled to double the annual charge. The authorities of the college soon became satisfied, also, that it was impossible to combine a systematic course of compulsory labor in case of a large number of students with a course of advanced education. Students who sought the latter preferred to go to institutions where the former was not required; while those who desire the former were generally unable or unwilling to remain long enough in the college to secure the latter. The trustees, accordingly, were compelled to choose between a comparatively low standard of education, combined with systematic labor, (including, as it did, every kind of severe and exhausting effort,) and a system which should furnish an education of much higher type, with only so much labor as was needed to illustrate the application of principles. The latter was adopted. The experiment might have been longer continued, had not the act of Congress of 1862 clearly pointed in the direction which experience had already shown to be the wise one. But with that act as a binding part of their charter, they were obliged to provide a liberal education, as far as possible, for all the industrial classes, "in the several pursuits and professions in life." But so far as we are able to ascertain, the proportion of students who go back to the farm now is as great as when the design of the institution was more exclusively agricultural.

EDUCATED YOUNG MEN LIKELY TO SEEK VARIED EMPLOYMENT.

Young men, whether graduates of a college or not, are likely to follow those callings for which they are best adapted, or in which the prizes in life seem most easily within reach; and the avenues to successful efforts are open in so many directions in our time that all cannot be expected to choose the same pursuits. Many educated young men who would be glad to engage in farming are prevented for want of ready capital, which is not so much required for beginning in other employments, and even in cases where the necessary capital can be procured, many prefer the immediate rewards offered elsewhere, to the slow but more substantial gains of agriculture. So long as the State college provides every needed facility for acquiring a thorough agricultural education, there would seem to be little justice in attempting to make it responsible for the failure of students to avail themselves of its advantages. It would be equally unjust to measure the benefit of such an institution by the number of its graduates alone. While the total number of its graduates, up to 1881, was only one hundred and nine, the number of its students for the same period was nearly one thousand five hundred, and these, as far as the records show, have gone largely into industrial pursuits, rather than the so-called professions.

The location of the college has sometimes been urged against it, and it is probably true that some disadvantage has heretofore arisen from that cause; but the means of communication with it have greatly improved since its establishment, and there is now good prospect that that a railroad will soon run directly to it. With its facilities

for easy access improved, the remarkable beauty of its situation, the salubrity of ts climate, the freedom of its surroundings from temptations to immorality and extravagance, cannot fail to secure for it the support and patronage of the people of the State.

COMPARED WITH SISTER COLLEGES.

The attention of the committee was called by one of the witnesses to the condition of Cornell University and the Illinois Industrial University, as contrasted with that of the State College, for the purpose of indicating that the latter has been mismanaged. On inquiry, we find that the cases are in no respect parallel. In New York, as is well known, a philanthropic citizen, the late Ezra Cornell, bought the entire land script from the State, paying the market price for it, and agreeing to locate and hold it, and to give the university the benefit of its advance in price. The result is, that all the lands sold have brought high figures; a considerable amount is still unsold, and the endowment of the university from that source alone will be from $3,000,000 to 4,000,000. In Illinois, the county of Champaign, in order to secure the location of the university, gave ample farms, amounting to several hundred acres, buildings ready for occupancy, and $200,000 in bonds, thus providing means for the immediate needs of a new and unorganized institution, and enabling the university to locate its lands advantageously, and hold them (as it did) for an advanced price. Besides this, the Legislature has, within the few years since its establishment, (1867), made appropriations from the treasury, for new buildings, apparatus, and equipments, amounting to about $400,000.

THE AVAILABLE FUND OF THIS COLLEGE.

The State of Pennsylvania had no such good fortune. Her landscrip amounted to seven hundred and eighty thousand acres, and it was undoubtedly the expectation of Congress that the lands would bring to the State at least the minimum market rate of one dollar and twenty-five cents per acre. Had this been the case the endowment of a State from that source alone would have been nearly a million dollars. But the large amount of scrip thrown upon the market at once so reduced the price that several of the States—our own among them—realized less than sixty cents an acre from the sales. We do not pass an opinion on others; but we believe it to be the duty of this Commonwealth, having accepted the deed of gift from the United States "with all its conditions and provisions," and having "pledged its faith to carry the same into effect," to restore the land-grant fund to the amount originally intended by Congress. The need of education for the industrial classes was never so great as now. The vast mining, manufacturing, and agricultural resources and activities of the State demand for their most rapid and economical development all the aid that can be derived from the most advanced teachings of science, and it seems not too much to expect that a State famous for the extent and wisdom of her charitable and reformatory agencies should make full and even generous provision for the higher education of her strong and aspiring youth. In conclusion, the result of a most careful and painstaking examination has fully convinced us that the State college is in good faith fulfilling the trusts committed to it by the State, and that much of the misconception respecting it arises from a lack of easily obtainable information. We believe it has passed its worst days. Its courses of study, in the opinion of experts, are well organized; its facilities good, and in some particulars unusually complete; its faculty is composed of competent, and many of them highly experienced professors; and whatever mistakes it may have made in the past, the entire spirit and work of the institution, as now organized and administered, are directed to the promotion of industrial education.

THE NEEDS OF THE COLLEGE SHOULD BE MET BY THE STATE.

The needs of such an institution are little appreciated by the public generally. Cornell University has an annual income of about $100,000, and Harvard University nearly $100,000. In comparison with these sums, the $30,000 of the State college is but a mere pittance, which in our judgment, the State may wisely supplement. The college has been carrying a floating debt of about $50,000 for many years, the annual interest on which is a considerable draft on its resources. It has two outlying farms, which involve expense, and which it is doubtful if any such institution can properly manage at so great a distance. The department of mechanic arts is in need of a more commodious building, exclusively devoted to its use. The chapel is no longer large enough to accommodate the numbers who attend on public occasions, and a new and sightly structure is greatly needed.

These immediate needs of the college we believe it would be a sound and wise policy for the State to supply. Although in its organization a private corporation, it is in every proper sense the child of the State, and we are strongly impressed with the conviction that the time has come when the State should give it such fostering care as will make it not only an object of just pride, but a source of immeasurable benefit to our sons and daughters.

In case the Legislature should adopt the line of policy herein proposed, it might be thought advisable to modify, with the consent of the corporation, the existing constitution of the board of trustees, either by making it more largely representative, or more directly amenable to the control of the State government.

In conclusion, your committee would most respectfully represent, that a re-organization of the board of trustees seems imperatively required if the purposes of the State college are to be realized by the agricultural and mechanical classes of the State, to the extent of its original design. The law that made the agricultural societies the custodians of the welfare of this school, seemed at the time to be the best that could be done; but their change of character since that time has unfitted them for this responsible duty, as their failure to participate in the annual meetings clearly demonstrates. By the same law, a number of State officials were made *ex-officio* members of the board; a duty they seem to have overlooked, as we find by the minutes of the board, their presence rarely, if ever, noticed.

It has also been suggested and strongly urged before the committee, that if the Legislature sees fit to authorize the sale of the experimental farms that an Experimental Station should be established. We think this a good suggestion, and would recommend the subject to the careful consideration of the Legislature. All of which is respectfully submitted.

AMOS H. MYLIN,
Chairman.
C. T. ALEXANDER,
JOHN C. NEWMYER,
GEO. W. HALL,
WM. B. ROBERTS.
Sub-Committee.

This report by the Legislature, so fully justifying the action of the Trustees and Faculty of the College, was calculated to promote the interests and popularity of the College.

PRESIDENT ATHERTON, CALLED TO THE COLLEGE.

About this time, 1882, Professor George W. Atherton, of Rutgers College, New Brunswick, New Jersey, was called to the Presidency. Professor Atherton had, long before, become widely known among

American Educators, through the exhaustive and interesting paper on "The relation of the General Government to Education" read by him before the National Teachers' Association, at the meeting at Elmira, New York, August 6th, 1873; an admirable historical summary, showing that the policy of the General Government in aid of Education has been uniform and liberal, beginning with the enactment of the ordinances of 1785, and 1787, in setting apart portions of the public domain for education.

Under the new president the progress of the college has been continuous in the line of the modern educational movements.

A NEW BUILDING FOR THE INDUSTRIAL DEPARTMENTS.

The Industrial Departments of the College were greatly in need of additional accommodations and through the efforts of the President, a new building for the Department of Mechanic Arts, was built and inaugurated with appropriate ceremonies, February 10th, 1886.*

On this occasion public exercises were held in the College Chapel. Professor John Hamilton of the College, delivered the principal address; which, as it relates entirely to the movement for Industrial and Art Education to which this Report is given, will be found in the Appendix.† The addresses by General Beaver, and President Atherton, which relate directly to the College, are here given in full.

General James A. Beaver, Governor of the State, at that time chairman of the Executive Committee of the Trustees, followed Professor Hamilton.

GEN. BEAVER'S ADDRESS.

Ladies and Gentlemen:—In one of the admirable series of short biographies of American statesmen now being issued by the press of Houghton, Mifflin & Co., Mr. John T. Morse, Jr., says in relation to the choice by John Adams of his life work: "A youth who had received a college education at a cost of not inconsiderable sacrifice on the part of his parents, lay in those days under a sort of a moral obligation to adopt a profession. Between law, divinity and medicine, therefore, Adams had to make his choice." It is to be said, however, that such a choice in those days was one not so much of moral obligation as of absolute necessity. Those of us who are college graduates of twenty-five years' standing, can well remember that in our class prophesies there was, so far as professional choice was concerned, nothing beyond law, divinity and medicine. Indeed, the education acquired by young men in this country prior to 1860, may be said to have in a measure unfitted them for what may now be termed, the *practical* professions of life. The application of steam and in later years of electricity to practical uses, opened the way for the employment of men of education in many pursuits which had previously been closed to those who had attained any considerable amount of mental training. The fact is, that the mental training which men received in our colleges, was such as to unfit them for practical pursuits, and many were helpless when they finished their educa-

*"The Pennsylvania State College Addresses delivered on occasion of the opening of the new building for the Department of Mechanic Arts, February 10, 1886. State College, Centre Co., Pa. Pp. 22."

†See Appendix Z.

tion, except so far as they might serve to crowd already overcrowded professions, and were many times compelled to occupy a subordinate place in those professions, when, had their education been of a practical character and properly directed, they might have reached usefulness and eminence in the walks of life which are now not only open, but which welcome men of scientific education and attainments.

The Modern Demand for a Practical Education in Science.

The call for men of practical education was made long before our educational institutions were able to heed the call, or to supply the demand. The men who founded this institution, although many of them college-bred men, recognized the call for a more practical education, and endeavored in good faith to meet the wants of the community in that direction. The education which the present age demands is not only a training of the mind which will enable men to think, but a symmetrical training of mind and hand, of eye and ear, so that the mind can guide the eye and the hand in applying the knowledge acquired to the practical solution of problems which concern our every day life. What has already been said on this occasion and what yet remains to be said by others, will more fully and intelligently present this subject than I could do even if time and the part which is assigned to me in this service permitted my engaging in the discussion. Suffice it to say, that we are met this afternoon for the purpose of formally setting apart to the uses for which it has been designed, a building to be devoted to the training of the eye and hand in connection with the system of liberal education which this college seeks to supply to those who are ready to make use of the advantages which it offers to the young men and young women of our commonwealth. The building is not such an one as the trustees would have been glad to have erected had the funds available for the purpose warranted it. As is well known to those who are familiar with the history and organization of the institution, no part of the income of the college can be applied "directly or indirectly under any pretense whatever to the purchase, erection, preservation or repair of any building or buildings." The trustees are therefore unable, even if the income of the endowment of the college warranted it, to expend any money thus received in the erection of shops, laboratories, chapel, library, propagating and green-houses, and separate buildings for the ladies and preparatory department, all of which are greatly needed and to the necessity for which they are keenly alive.

How This New Building Was Made Possible.

The new building, which we formally open this day, modest and unpretentious as it is, could not have been built by the trustees but for the fact that a small fund was accumulated under the direction of the President of the college, and by the skill and industry of one of its professors in securing and performing scientific work which yielded something of an income, and which by being carefully husbanded furnished a fund which has been expended under the direction of the executive committee of the board of trustees.

This fund, amounting to something less than $3,000, has with but little addition, erected and equipped the building which you will shortly be invited to inspect. It is a notable and somewhat curious fact that outside of the fund already referred to, the only contribution to the equipment of the building was that of a manufacturer of New England who generously donated to the professor in charge of the Mechanic Arts Department a portion of the equipment of the forge room, which donation amounted to about five hundred dollars. The executive committee deem themselves fortunate in having contracted with Messrs. P. B. Crider & Son, of Bellefonte, for the erection of the building. The contract price was $1,525. A few extra items contracted for during the course of its construction made the entire cost of

the building about $1,650. Its entire equipment, outside of the donation of Mr. B. F. Sturtevant, including steam heating, shafting connecting with the engine in the engine house, machinery of every description and tools cost, in addition to the price of building, about $1,800.

As part of the improvement, the committee also caused to be constructed a cistern or reservoir for holding the rain water from the engine house and Mechanic Arts building, so as to supply the boiler which furnishes power for the engine with an abundant supply of soft water. This cistern, with the foundations of the building, cost about $400. The entire cost therefore of building, equipment and of the cistern amounts to about $3,800. This has all been paid out of the fund realized from the analysis of fertilizers and other work in the chemical department, except about $900. The college is to be congratulated, not only upon the increase of its facilities for imparting practical education which this building affords, but also upon the fact that it has within itself and through practical work in other directions secured the funds by which these additional facilities are provided. The executive committee feel in thus closing their work and handing the building over to the trustees as the custodians of the college property, and to the faculty as the agency which must necessarily control the educational machinery of the college, that they have done all with the amount of money at their disposal which it was possible to do. Indeed, the building and its equipment have both grown in extent, appearance and completeness greatly beyond what was expected or hoped for when the work was commenced.

We wish to acknowledge the obligations of the institution to Dr. Atherton, who was instrumental in securing from the state board of agriculture the work which afforded the means for this improvement; to Professor Jordan, the late efficient professor of agriculture, for doing that work, or having it done under his direction; to Mr. Patterson, superintendent of the farm, for his care and oversight in preparing foundations, and overseeing the work at the cistern; to Messrs. P. B. Crider & Son, the contractors, for the faithful and liberal way in which they complied with the terms of their contract; to Professor Reber for his constant care and supervision during the construction and equipment of the building, and especially to Mr. B. F. Sturtevant, Brookline, Mass., who made such a liberal contribution toward the equipment of the building. The latter gentleman has afforded an example which might be well followed by our Pennsylvania manufacturers, who could still further add by their liberality to the complete equipment of our Mechanic Arts department. The work of the committee is done; how well done with the means at hand you can better determine after you have inspected the building, which will be thrown open to you when the exercises in the chapel have ended. It only remains, therefore, for me, as the representative of the committee, formally to transfer the custody of the building to the representative of the trustees and the faculty. In the absence of the president of the board of trustees (Colonel Jordan) I have the honor of making this transfer, which is symbolized by the possession of the keys of the building, to Dr. Atherton, the President of the college and the Secretary of the board of trustees. Our hope is that this department, with its enlarged equipment and facilities for work, will enable the college to enter upon the wide field which opens before it in this direction, and to cultivate that field in such a way as to give practical instruction to the young men who shall be brought under its direction and control, and fit them for usefulness and eminence in the practical walks of life, which are calling more loudly than ever before for trained men to fill their places of influence and emolument.

The President's Address.

Dr. Geo. W. Atherton, President of the college, replied to the committee's report in the following:

Mr. Chairman:—I accept these keys on behalf of the trustees and the faculty, with a full appreciation of all that they symbolize of trust and responsibility; and I confidently pledge both of these bodies to a full and faithful discharge of the enlarged duties thus imposed upon them.

Ladies and Gentlemen:—Your welcome presence here to-day is a gratifying proof of your friendly interest in the prosperity of the State College, and especially in that department which now enters upon a new and advanced stage of progress. After the admirable addresses to which you have already listened, it seems hardly necessary for me to add anything on the general subject; but I may, perhaps, with propriety, attempt to point out the relation which exists between our general system of instruction in the college and the department of Mechanic Arts.

The general scope of our work could not be expressed with more force and fullness than in those striking words of the act of Congress which have already been quoted by a previous speaker. The states are "to establish and maintain at least one college, in which the leading object shall be, without excluding other scientific and classical studies, (and including military tactics,) to teach such branches of learning as are related to agriculture and the Mechanic Arts,"

THE CLASS OF INSTITUTIONS, DESIGNATED BY THE WORD "COLLEGE", WELL UNDERSTOOD.

It should be especially noted that the word "college" had, at the time of the passage of the act, (1862,) and has always had, a distinct, well understood, and almost technical meaning. It is the name applicable to an institution of general and liberal higher education, as distinguished from preparatory, and professional, schools of every name and grade. It is a place where youth are to pursue a systematic and progressive course of intellectual training; in order that, with disciplined powers and with a knowledge of the leading principles of a few great departments of human learning, they may be prepared to enter successfully upon the studies and the activities of any chosen pursuit. The act of Congress, then, in using a word whose signification was so well established, clearly indicated the grade of work which these institutions were to undertake. But the words immediately succeeding are, if possible, still less open to doubt. The colleges are to teach not handicrafts or trades, but "branches of learning," and are to teach them in such a way as "to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life." The difference, however, between these and the old colleges was marked by the words used to designate *what* "branches of learning" were to be taught as a "leading object." The instruction was to be of collegiate grade and extent. Nothing lower can satisfy the plain intent of the law; and I emphasize the point, because so many mistaken attempts have been made to drag the colleges down from this high standard. But the branches of learning taught were to be such 'as are related to agriculture and the Mechanic Arts," and it must be conceded that, in thus fixing a limitation, the act was to that extent a departure from the strict "college" idea, as already indicated. It raised, however, a question of the very first importance, not only as of practical application in the work of the new colleges, but as affecting the whole theory of education. I have not time to discuss the question, but only to state it. It is no other than the standing question between the "old" and the "new" educations. Can these branches of learning be so taught as to impart a "liberal" education, of equal disciplinary value with the classical training? The justification of the colleges by no means depends upon an affirmative answer to this question; but its very implication in the terms of the act of Congress clearly points out the direction they are to follow. They are to impart a liberal education, but they are to do it by giving instruction in that wide range of the mathematical, physical and natural sciences, which underlie the vast activities of modern industry.

ESSENTIAL CONDITIONS OF GOOD EDUCATION.

As to the best method of teaching the applied or experimental sciences, there may be said to be three leading theories: To teach theoretical principles only, leaving applications to be learned by subsequent practice; to teach practice only, leaving principles to be deduced mainly from experience and observation; to teach theory and practice together. The first of these methods is applicable, if at all, only to the highest ranges of teaching; the second, only to the lowest, and is a teaching of trades based upon sciences, rather than of the sciences themselves. The third is the only method generally available either for education or for practical training.

All sound education should furnish, (1) intellectual training, (2) an instrument for practical use. The work of our department of Mechanic Arts, in its enlarged scope, will aim to accomplish these two ends. It will furnish a thorough training in the foundation of mathematics, including algebra, geometry, trigonometry and elementary mechanics. It will teach the structure and use of the English language in order that every student may be able to express himself correctly and intelligently. It will teach the applications of principles in the elements of natural philosophy, surveying and mechanism. Side by side with this theoretical instruction, will be given a progressive course of instruction in drawing, from the simplest freehand through the various grades of geometrical drawing up to designs of machinery. There will also be a graduated course of manual training, covering all the leading principles of wood-work and iron-work. The amount of time given to this practical side of training, will, in the aggregate, somewhat exceed that devoted to textbook instruction. In the first year of the course, the proportion of the text-book instruction to practical training is as 39 : 33; in the second year, 33 to 35; and in the third 28 : 48; thus showing a progressive and rapid increase of the practical element.

PURPOSE OF THE COURSE IN MECHANIC ARTS.

The object of the course will be not to teach a trade, but to give such knowledge of principles and their applications as will combine a well proportioned development of skill in the hand, the eye, and the brain. A student so instructed, before entering upon his chosen line of employment, will need to spend some time in becoming familiar with the practical details of its working methods. But his knowledge of principles, his manual skill, and his habit of testing all operations by scientific standards, will give him a rapid and easy mastery of his craft and place him on the sure road to promotion. It is stated that, in France, graduates from such courses fail, at first, in the economical use of time and material; but that, after a slight degree of experience, they advance rapidly to the foremost positions.

With regard to the mooted point whether the course shall follow the method of "instruction" or that of "construction," no final decision has yet been made. We hope to learn by experience. The principal object certainly will be to fix the student's attention upon those principles and processes which are of universal application; following, to this extent, the "instruction" method. But the advantages of the other method in giving practical skill, developing the constructive faculty, and in guiding the student's ambition toward a completed product, lead me to believe that we may profitably give some attention to commercial work. The further question has often been discussed whether instruction of this kind can be more successfully carried on in separate institutions or in association with other departments. Each system has its own advantages. I have no doubt that, for this country in general and for ourselves in particular, the broadening influences of association with those engaged in other lines of instruction and research, are an advantage sufficient to outweigh whatever benefits may belong to separate establishments.

TECHNICAL EDUCATION IN EUROPE.

The path thus marked out for ourselves is not untried. The marvellous advances of scientific discovery in modern times, the numberless and wonderful inventions for lightening human toil, and, especially, the myriad applications of steam and electricity, have created a material revolution which has changed the face of the industrial world. To meet the requirements of this change, every civilized nation has found it necessary to create a system of industrial education adapted to the new conditions. Four nations of continental Europe have taken the lead in this direction, viz: Belgium, France, Germany and Switzerland, and they have now come to hold a place of recognized pre-eminence in industrial skill. Each of these countries has created and maintained an extensive system of institutions, covering every branch of industrial training, including trade schools, pure and simple, scientific schools of a higher grade, in which only so much practice is included as will serve to illustrate the application of principles, and polytechnic schools devoted exclusively to theoretical instruction in the highest branches of engineering and other branches of applied science. The uniform experience of these countries shows that the training given in these several institutions not only increases the general intelligence of the pupils, but has a distinct and appreciable market value, by increasing the thoroughness and the artistic quality of the work produced. Other countries, as Russia and Italy, have entered earnestly upon the establishment of similar systems, and it is no exaggeration to say that the idea of scientific industrial education, in its manifold forms, has become one of the controlling forces in the present phase of European civilization.

It is this widespread and almost universal technical training which has given the four countries named control of the markets of the world in the products of skilled labor. A British royal commission, appointed in 1881, visited these countries and made an extensive examination of their systems of industrial training. Their observations not only conclusively prove the superiority of the countries visited, but unhesitatingly attribute it to this training. And they strongly insist that, if England is to hold her present leadership in some directions, or to secure it in others, it can only be by adopting methods of industrial education which have proved so effective on the continent.

THE DEMAND FOR THEORISTS LIMITED.

There is one teaching of this experience which has special significance for us. It is found that the supply of graduates from the theoretical technical courses tends to exceed the demand, somewhat as the product of the professional schools fills to overflowing the ranks of ministers, doctors and lawyers. In Germany, alone, it is found that there is an excess of more than one thousand unemployed graduates in engineering; and one proprietor of a large engineering establishment is mentioned who found himself obliged to post a conspicuous notice: "No polytechnic need apply." This state of things has made itself so apparent that not more than two thousand students are in attendance at the Polytechnic institutions which have accommodations for six thousand. And the experience of Germany, in respect to the over-supply of highly trained specialists, is being repeated in the United States, as well as in other European countries. But the demand for those who have received an intermediate grade of instruction, combining theory and practice in due proportion, is practically unlimited.

AMPLE EDUCATIONAL FACILITIES POSSESSED BY THIS COLLEGE.

No valuable result has been attained elsewhere which is not equally within our reach, and which our circumstances do not equally call for. Our abundant agricultural and mineral wealth, combined with the activity, intelligence and enterprise

of our people, have secured us, hitherto, an easy superiority in some departments of production. But in the highest forms of industry, especially such as involve the artistic element, we are still far behind. The value of raw material, compared with the value of finished products, is very slight. The higher the form of industry the greater this difference becomes. But with the advancement of refinement and intelligence in society, the higher forms of production tend to increase in number, variety and artistic excellence; and the people which is best prepared to meet these advanced requirements will most rapidly advance in wealth and general prosperity. No people has ever existed on the face of the earth possessing so high a degree of general intelligence, flexibility of powers and adaptability to varied conditions, as our own. Given these high natural endowments, these boundless material resources, and nothing but an adequate system of industrial training is requisite to give us pre-eminence in the sciences and arts of life, as we already hold it in the science and art of government. As a means toward this great end, the department of Mechanic Arts in the "State College" is to be religiously used.

THE MILITARY TRAINING COMMENDED.

There is one other feature of our work which I trust we shall never overlook. Our system of military training occupies a subordinate, but highly important place, not only as required by an honest compliance with the law of Congress, but as an admirable gymnastic and a means of preparing a citizen soldiery to defend by arms, if need be, a citizen's government. But beyond this, and in all his relations, we mean never to lose sight of the fact that the student is a man and a citizen—that he is not to be trained as a mere machine, however perfect, but as an intelligent and responsible being, destined to perform his part and to exercise his influence in our great system of free institutions. We hope, therefore, that the whole tone and spirit of the college will be such as to inculcate the sound qualities of character and the high virtues which are the foundation alike of national and individual prosperity.

At the close of his address, President Atherton asked all those present to visit the Mechanic Arts building, which is located a short distance from the college building proper.

BRIEF DESCRIPTION OF THE BUILDING.

The building is of wood, but very neatly and substantially constructed. The apartments consist of four rooms, a forge and lathe room on the first floor, while in the second floor is a turning and a carpenter shop. All the tools and appliances used are of the best that could be procured anywhere. The tools are made of the best material and consist of the latest employed in modern mechanic arts. The course is designed to afford such students as have had the ordinary common school education an opportunity to continue the elementary, scientific and literary studies, together with mechanical and free-hand drawing, while receiving theoretical and practical instruction in the various mechanical arts. The instruction in shop work is given by means of exercises so planned as to cover, in a systematic manner, the operations in use in the various trades, and only such constructions are made as cover principles without undue repetition.

A detailed account of the shops, tools, and machinery followed; omitted here, because given later in the report of Professor Reber. A list of those present closes the pamphlet account, which is reprinted from the report in the Keystone Gazette of Bellefonte, Pennsylvania, of February 19th, 1886.

The Annual Report made by the College to the Legislature, for

1886,* is a volume of several hundred pages, illustrated with view of the college and grounds, and of the new building for the Mechanical Department, with plans of the floors; and, also, with nearly sixty pages of illustrations, showing the lessons given in wood working,—both by hand and machine; and in iron working; both in forging, vise work and machine work.

Such extracts are here given from the President's report, as relate to the studies of the college.—The various professors in charge of different departments follow with detailed reports; the report showing the Agricultural experiment work, is very voluminous.

PRESIDENT'S REPORT.

"*To the Board of Trustees of the Pennsylvania State College:*

Gentlemen: I have the honor herewith to submit my report of the operations of the State College for the year 1886, together with the reports of the several departments. * * *

In the courses of study, some very important modifications have been made during the year, the principal one, perhaps, being the establishment by the board at its last meeting, on the recommendation of the faculty, of the new course in Mechanical Engineering. Several students have already chosen this course, and it has brought inquiries from many directions.

The course in Mathematics has been carefully re-adjusted and graduated from the beginning of the preparatory to the end of the college work. A difficult standing problem in this branch of our work is to secure a sufficient amount of Mathematics to form the basis of the technical courses, without making it so extended as to overload students in the general courses. The problem would be easily solved, if the college could afford to maintain two courses in Mathematics during the freshman and sophomore years, the ordinary one for general students and a more advanced and exacting one for technical students. But until that time comes, it is hoped that the difficulty of the situation will be greatly relieved by the modifications referred to. In the meantime, students who may wish to pursue special branches of advanced mathematics can do so by selecting such subjects from the courses in Mechanical and Civil Engineering and in Physics. The faculty have also under consideration, and will probably report to the board or the Executive Committee, a more extended course in Physics, with special reference to the recent advances in electrical science. Such a course is already asked for by our students, and is indispensable to anything like completeness in our physical instruction.

From the statements just made respecting the group of courses, it will be seen that this side of our work is becoming strong and effective. It has been made more definite and systematic, and the several allied courses of Mathematics, Civil Engineering, Mechanical Engineering, and Physics have been brought into a better coördination and a relation of mutual support. This, in connection with the vigorous and successful working of our course in Mechanic Arts, thoroughly meets the requirement of the law of Congress, that one of the leading objects of the college shall be to teach such branches of learning as are related to the Mechanic Arts.

DEVELOPMENT OF THE COURSE IN THE STUDIES RELATED TO AGRICULTURE.

The work of the college in the other direction prescribed by Congress, the teaching of such branches of learning as are related to agriculture, is equally thorough.

*"Report of the Pennsylvania State College, for the year 1886, with the Financial Reports for 1885 and 1886. Harrisburg: Edwin K. Meyers, State Printer. 1887. Pp. 405."

Physiology, Zoölogy, Botany. Geology, and Chemistry enter into all our regular courses of study; while, in the three courses in agriculture, they are amplified, and are supplemented by kindred subjects directly related to the science and practice of farming. Our experimental work is extensive, systematic, and as exact in methods and results as it can be made by intelligent care and patience, guided by the latest advances in agricultural science. I believe there is not to be found elsewhere in the United States so valuable a series of continuous experiments in certain lines of crop production as those that have been carried on at the central experimental farm near the college. The work is now in better condition than ever before, and promises increasingly valuable results. The appliances for cattle feeding experiments have been largely increased, and the work in that direction systematically continued. The publication of bulletins from time to time by the college, giving accounts of the most prominent and useful features of these various experiments, has been continued, and the demand for them has increased until our regular mailing list now numbers nearly ten thousand names, and will soon exceed that number.

This experiment work and the preparation of bulletins have been conducted during the year by Professor Frear, almost without assistance. His duties have been extremely burdensome and are entitled to the cordial recognition of the board. But if they are to be continued on the present scale, still more, if they are to meet increasing requirements, it will be necessary to provide some additional assistance, which I strongly recommend.

THE WORK UNDERTAKEN BY THE COLLEGE IN ITS SEVERAL COURSES OF STUDY.

It will thus be seen that the college is now carrying on three main lines of educational work, viz: In the sciences related to Agriculture; in Mathematics, with its applications in Physics, Mechanics, and Engineering; and in general education. Under the law controlling the policy of the college, we cannot properly undertake less, and with these three lines well manned and equipped, we shall have no need to attempt more. The character of our general educational work is greatly influenced by that of the technical courses. The first two years are designed to furnish a sound and strong foundation for the advanced work of these courses, as well as for the more general training given in the General Science course. That course, to use a statement made elsewhere by the college, "is designed to meet the wants of those who desire to obtain a sound and liberal education through the study of the Mathematical, Physical, and Natural Sciences, and Modern Languages and Literatures, rather than the Ancient Classics. It provides a thorough training in Mathematics and Physics, (with the option of the Calculus in the junior year,) a sufficient acquaintance with the leading branches of Natural Science (as Chemistry, Botany, Geology, &c.,) and as much study of Mental, Moral, and Political and Historical Science as is found in the usual college course, while the literary studies include an extensive reading of French, German, and English Literatures and literary history. No student can fairly complete this course without having acquired a stock of recent knowledge and a degree of intellectual training which will fit him to enter successfully upon any chosen career and furnish an admirable and effective equipment for the duties of American life and citizenship." We are keeping steadily in view the purpose to make this training equal to that of the classical colleges, as a mental discipline, but at the same time to teach all subjects with constant reference to their practical applications in the business of life. The good results of our work are already showing themselves in the careers of recent graduates, all of whom are doing well, and some of whom have won rapid and striking success. * * *

THE PRESSING NEEDS OF THE COLLEGE.

It may seem ungracious to remind the board again of the many needs of the college in the way of material equipment. What we have is already extensive and

excellent, but our growing needs far outrun our resources. To summerize the most urgent needs, they are, a new building for the Preparatory Department, a new Chemical and Physical laboratory, a hall for public occasions, a greenhouse and Botanical laboratory, and a large increase of equipment for the library, the Mechanical, the Physical, and the Civil Engineering Department. Two hundred thousand dollars ($200,000) could be immediately and wisely expended. Such a sum is, of course, beyond the power of the board to raise, but the present condition and work of the college are such as to justify us in asking the State to grant some immediate aid—such aid as will enable the college more fully to meet the original design of Congress, render it more worthy of a great and powerful Commonwealth with whose reputation it is inseparably connected, and fulfill the solemn pledges made by the State when accepting the national grant of land. * * *

In closing, I desire in this public manner to express my thanks to the faculty for their faithful coöperation, and to the board for its unfailing confidence and support.

Respectfully submitted,

GEORGE W. ATHERTON,
President."

JANUARY 25, 1887.

The following, is from the official statement of the course of study in Mechanic Arts. (See report to the Legislature; pages 314–318, inclusive.)

COURSE IN MECHANIC ARTS.

(Combining Shop-Work and Study.)

The course was reorganized in September, 1884, and met with so much success during the following year that the trustees found it advisable to construct and equip a new two-story building, 50 x 34 feet, which is now ready for occupancy. The building is divided into four main compartments—a carpenter shop and a wood-turning room on the second floor, and a forge room and a machine shop on the first floor.

In the forge room there is a small compartment for keeping iron, and in the machine shop is a tool room. There is also a long sink with basins and with hot and cold water connections for washing purposes.

The equipment is the best modern machinery necessary to give the instruction as indicated in the accompanying schedule.

The course is designed to afford such students as have had the ordinary common-school education an opportunity to continue the elementary, scientific and literary studies, together with mechanical and freehand drawing while receiving theoretical and practical instruction in the various mechanical arts.

The instruction in shop-work is given by means of exercises so planned as to cover, in a systematic manner, the operations in use in the various trades.

The object of the course being to give instructions in the use of tools, only such constructions are made as to cover principle without undue repetitions.

1. BENCH WORK IN WOOD.

The first instruction is in carpentering. The student is assigned a bench which he will find provided with one cross-cutting saw, one ripping saw, smooth plane, jack plane, jointer, set of firmer chisels, set of framing chisels, drawing-knife, back saw, set of Pugh's bits, bit-brace, mallet, oil-stone, try-square, screw-driver, hammer, hatchet, two-foot rule, mortise and scratch gauge, bevel and nail set. Besides fourteen sets, as given above, there is a good supply of other tools which may be passed around to the students as needed, a full set of iron planes, heading and matching planes, hollow and round planes, clamps, screw boxes, &c., &c.

Particular attention is given to laying out work. This is looked upon as important, since it requires the application of fixed principles, combined with care, thought and judgment. The first exercise in this is the use of the saw and plane in working wood to give dimensions. and a series of exercises follow in order, such as practice in making square joints, different kinds of dove-tails, the various tenons, roof trusses, panels, &c., &c. There are twenty-five such exercises.

2. MACHINE WORK IN WOOD.

In this room are six turning lathes, a circular saw, and grind stone. The lathes are each provided with a complete set of gouges and chisels, parting tool, a pair of calipers and compasses and a two-foot rule. * * *

This course begins, after the last is thoroughly understood, with turning a plane cylinder, and ends, after twenty exercises, with a complicated vase.

3. PATTERN MAKING.

* * *. The work in this course is not so specifically laid down, as the range of applications for patterns is so great that there are an infinite number of exercises that would answer equally well, and in many cases the student will make patterns for some particular machine which he intends to build. * * * .

4. IRON AND STEEL FORGING.

In the forge room are at present seven forges, provided with water and cooling tank, and each supplied with air blast from one of B. F. Sturtevant's steel-pressure blowers; also a self-feeding post-drill and two large vises.

With each forge is an anvil, tongs, punches, hot and cold chisels, heading tools, hammer, swedging tools, set-hammers, flatters, fullers, &c., &c. In forging considerable time must be taken to acquire the elements of the work—in learning where, how and when a blow should be struck to give a desired result and to come able to keep the fire in good order. Being able to keep a good fire is essential to good results. After the twenty seven exercises in iron forging have been finished the student takes up steel forging. Having by this time acquired considerable skill in producing forms, his time is now mostly taken up in the hardening, tempering and annealing processes which are in common use. He now learns to make the various tools used in blacksmithing and engine lathe work, and is ready to prepare and dress his own tools when working in the machine shop.

5. VISE WORK IN IRON.

Eight vises are placed on substantial benches, around the sides of the machine shop, each fitted with a drawer in which the student keeps his work and the tools he may be using. In the tool room are eight complete set of tools, such as cold chisels, files, clipping hammers, file cards, calipers, squares, hand vises, &c. These are given out when needed and returned as soon as the student has finished using them, he being held responsible for them in the mean time. This course of twelve exercises is intended to give practice in the use of hand tools for metal and to teach the student how to keep them in order.

6. MACHINE WORK IN METAL.

The appliances for machine work are at present being purchased. One Harrington lathe, sixteen inch swing by six foot bed, one shaper, a speed lathe and a power grindstone, with a proper supply of chucks, cutters, drills, reamers, gauges, squares, calipers, &c., have already been received. It is expected to add several more lathes and a planer.

This course is designed to give the student a knowledge of the different machines and the methods of working them. * * *.

DRAWING.

The drawing of this course extends through the entire three years. This work is looked upon as of the highest importance, and the effort is to make the instruction thorough, practical and of direct utility. Considerable time is devoted to free-hand drawing, as it is believed that it not only assists in mechanical drawing, but is of great service in after years, whatever one's occupation.

The mechanical drawing consists of a series of exercises, such being selected as will be of subsequent use. They are arranged in progressive order, beginning with geometrical constructions involving straight lines and circular arcs only, and ending with the more complex curves, such as the ellipse, helix, epicycloid, etc. Projection is next taken up. The instruction in this is from models, so that the student may have before him the actual object from which the projection is made, and not be obliged to depend upon his unaided conception. After completing this work he is required to draw parts of machines from actual measurements. For this purpose he is given some piece of mechanism to sketch and measure, and of which finally he is to make complete working-drawings.

In Mathematics the instruction covers Algebra, Plane and Solid Geometry, Plane and Spherical Trigonometry, Land Surveying, Mechanics and Mechanism, taught with special reference to this class of students, many practical applications being made.

Course in Mechanic Arts.*

Years.	Session.	Studies.	Hours per Week.	Shop-Work and Drawing.	Hours per Week.
First Year.	Fall.	United States History, Arithmetic, ... English Grammar, . .	3 4 5	Carpentering, ... Geometrical Free-hand Drawing, ...	4 5
	Winter.	Algebra begun, . . . English Composition, . United States History,	5 5 5	Carpentering and Joining, Model and Object Drawing, ...	8 5
	Spring.	Algebra, ... English Composition, . Book-keeping, . . .	5 5 4	Wood-turning, ... Designing, ...	6 5
Second Year.	Fall.	Geometry, ... Algebra, ... Physics, ...	2 4 4	Pattern-making, ... Geometrical Drawing, . .	4 4
	Winter.	Geometry, ... Algebra, ... Physics, ... English, ...	2 4 4 2	Foundry Work, ... Orthographic Projection and Intersections, . . .	6 5
	Spring.	Geometry, ... Algebra, ... Mechanics, ... Civil Government, . .	4 5 3 2	Forging, ... Development of Surfaces and Isometric Perspective, ...	8 8

* Text-books for the first two years are the same as in the Preparatory Classes; for the third year, the same as in the Freshman Class, Mechanical Engineering Course.

Course in Mechanic Arts—Continued.

Years.	Session.	Studies.	Hours per Week.	Shop-Work and Drawing.	Hours per Week.
Third Year.	Fall.	Algebra, Geometry Mechanics,	3 3 4	Forging, Linear Perspective and Shades and Shadows,	6 9
	Winter.	Geometry, Trigonometry, Rhetoric,	3 3 4	Vise Work, Detail Drawing,	6 9
	Spring.	Trigonometry and Surveying, Mechanism,	5 3	Machine Tool work, Machine Designing,	9 9

REQUIREMENTS FOR ADMISSION.

Candidates for this course must be at least fourteen years of age, and pass a satisfactory examination in the following subjects: Robinson's Complete Arithmetic (or its equivalent) to Ratio. English Grammar (Syntax and Etymology); Geography and spelling.

The following extracts are from the text of the report made by the Professor of Mechanic Arts, in which are embodied the illustrations of the various lessons referred to above.

MECHANIC ARTS.

George W. Atherton, LL. D.,
President Pennsylvania State College:

Dear Sir: In order to give the Board of Trustees a knowledge of the scope and character of the work of the Department of Mechanic Arts, my report to you embraces not only a statement of its present condition, but also a full description of the methods of instruction in the different shops, together with plates of the work.

This department was founded several years ago, but in 1885 was reorganized and different branches of shop-work added. Previous to this year instruction only in carpentering was given, the carpenter shop being in a small attic above the engine house, neither properly lighted nor heated.

The new building, which is now occupied by shops, was completed last February, consequently it is only since that time that the department has been in good working condition, and the results of our last year's work give evidence of what can be accomplished under favorable circumstances.

IMPROVEMENTS.

As before stated, during the last year a two-story frame building, 34′ by 50′, was erected for the use of this department. The building is divided into four main compartments, viz: carpenter shop, wood-turning room, forge room and machine shop. Besides these, the attic of the engine house is used for a lumber room. * * *

While these shops are used for giving practical instruction to the students in mechanical engineering, civil engineering, and somewhat to the general students, it is from the mechanic arts that we have thus far gotten the best results, as the

mechanical engineering course has just been organized and in the other courses they are not kept in the shops such a length of time as to attain any great degree of efficiency in the work.

In the course in "Mechanic Arts" special prominence is given to manual education, it being intended for those who wish to enter upon industrial pursuits rather than to become scientific engineers. It is designed to afford such students as have had the ordinary common school education an opportunity to continue the elementary scientific and literary studies, together with mechanical and free-hand drawing, while receiving theoretical and practical instruction in the various mechanical arts.

The number of students in this course at present is thirteen, five being in the third and last year will consequently complete the course next June, and thus be the first to do so. * * *

The number of hours given to shop-work is not large, but it must be remembered that the students are under the eye of a competent mechanic whose sole object is to give instruction, and the work which has been produced from these shops shows what may be accomplished in so short a time under this system.

* * * * * * *

Although the shops have been running for less than a year, there are already almost as many students in them as can be accommodated. If the work continues to grow as it has, it will be but a short time until the shops will have to be extended in order to meet the demand.

Respectfully submitted.

LOUIS E. REBER,
Professor of Mechanical Engineering.

DECEMBER 28, 1886."

The following information of the College is from the Catalogue* for 1886–7. The description of the College, with which this account begins, is from this Catalogue, in which the facts which an intending student desires to know, are very clearly given. The collections, museums, laboratory appliances, library, etc., are well set forth.

COURSES OF STUDY.

The act of Congress of July 2, 1862, which, as has been already indicated, is of binding authority on the College, requires instruction to be given in a large number of subjects. Provision has accordingly been made for as full compliance with the act as is possible, until, by the generosity of private donors or the liberality of the State, an increase of resources shall make possible an increase of teaching force and equipment.

The College now offers thorough instruction and ample facilities in three *General Courses*, five *Technical Courses*, and four short *Special Courses*, which are fully described under the headings "Courses of Instruction" and "Departments of Instruction." Provision is also made for Select or Partial courses according to the desire or fitness of students.

COURSES OF INSTRUCTION.

The organization of the College is such that the instruction given naturally falls under several departments, which are distinct, and yet so mutually related as to form, when combined in groups, well-proportioned, systematic, and progressive Courses of Study. The number of such courses is now seven, viz: A General Science Course, a Latin-Scientific Course, a General Course in Agriculture, five Tech-

*"Catalogue of the Pennsylvania State College, 1886–'87. State College, Centre County, Penna. 1887. Pp. 64,"

nical Courses, designated as Courses in Agriculture, Chemistry and Physics, Civil Engineering, Mechanical Engineering, and Natural History, respectively. There are, also, four shorter Special Courses. In three of the Technical Courses the studies *are the same for the first two years* as those in the General Science or the Latin-Scientific Course, at the option of thestudents in the Civil and Mechanical Engineering Courses they are slightly varied with reference to the later stages of the work.

All students, accordingly, who intend taking a regular course (other than in Civil or Mechanical Engineering) enter the General Science Course, or the Latin-Scientific, at the beginning of the Freshman year, continue its studies until the end of the Sophomore year, and then either complete that course or select the Technical Course which prepares directly for their chosen work. The studies of the first two years are so arranged as to form a course by themselves, especially adapted to meet the wants of those who cannot take a full college course, but who desire to fit themselves well as land surveyors, or for any of the ordinary callings of life, at the same time acquiring a fair degree of liberal education.

Students leaving at this period of their course receive from the Faculty a certificate of their attainments. * * *.

The following, are the detailed announcements of the special studies in which drawing enters:

3. Civil Engineering.

The work of this Course is arranged with reference to the demands made upon the Engineer by the theory and practice of his profession. The harmony between these and their close mutual relations and dependence are dwelt upon and developed as giving the broadest grasp and clearest conception of the actual problems arising in professional work—problems that demand the ability to design, or plan, or execute, and which combine both the science and art of Engineering.

The theory, and a portion of the practice, is taught by text-books, lectures, theses, and work at the drawing-board; the remainder of the practice, by field and shop work, draughting, model construction, and visits to points of Engineering interest.

The Technical studies begin, in the Spring Session of the Sophomore year, with Descriptive Geometry and the Principles of Mechanism. Special attention is given to the study of the former, not only because a thorough knowledge of it is essential to the Engineer, but also on account of the mental training it gives. Sufficient time is allowed to enable a student to apply its principles to: (1) Problems on right lines and planes, warped and single and double curved surfaces; (2) Spherical Projections and Map Drawing; (3) Shades and Shadows, and Isometric Projection; (4) Stereotomy, including the solution in the drawing-room of original problems under each sub-division.

Mechanics, owing to its great importance, is taught throughout the Junior year, the Fall Session being devoted largely to Rational methods. Analytical and Graphical methods are developed coincidently, the purpose being to accustom the student to choose intelligently which of the methods to use, or when to combine them. Surveying, Least Squares, Practical Astronomy and Geodesy, and Engineering Structures complete the work of this year. During the Senior year, the time allotted to technical subjects is devoted to lectures on the several branches of Civil Engineering, viz.: Sewerage and Drainage, Hydraulic Engineering, River and Harbor Improvements, Economics of Roads and Railroads. Designing is made a prominent feature in the work of this year, and much time is devoted to it. In order to familiarize the student with the legal forms used in connection with every Engineering work of importance, the subject of Engineering Specifications and

Contracts is taught, and this, together with Heat, Steam, and Steam Engines, and Hydraulic Motors, completes the work of the Senior Class.

During the Winter and Spring Sessions of the Senior year, the student is required to prepare a graduation thesis, which must show satisfactory evidence of independence of thought in considering and treating Engineering problems.

PRACTICUMS.—Although methods of practical work, and rapidity of executing them can only be learned from experience, yet there is much of the routine work of the Engineer in field and drawing-room that can be brought within the scope of the student's practical training, and his work is arranged with reference to this fact. The practicums of the Freshman year are Drawing and Shop Work, the latter consisting of the Principles of Carpentry, Wood Turning and Metal Work. During the Sophomore year, there is added Land Surveying, Descriptive Geometry, and Chemistry. During the Junior and Senior years, the field work includes Railroad Surveying, Geodesy (measuring Case line and triangulation), Topographical Surveying, Determination of Latitude, Time, Azimuth, and Barometric Leveling. The College is so situated that the operations of surveying can be carried out on a large scale, and thus made in a marked degree practical. During the Winter Session the practicum time is given to Engineering, Draughting, Computations, and Model Construction."

5. GRAPHICS.

The rapid development of the work in the department of Civil Engineering, within the last few years, has been accompanied by an equally important extension of the work in free-hand, industrial, and mechanical drawing. Instruction in this subject, however, is not confined to the Technical Courses, but, on account of its great value as a means of training the perceptive faculties, and its almost numberless applications in every art and trade, it occupies a considerable portion of the practicum time in every course, including the classes in the Preparatory Department, where a good foundation is laid.

During the fall session of the Freshman year, the student is instructed in free-hand and elementary projection drawing. This is followed during the remainder of the year by mechanical drawing, and the fundamental principles of isometric and oblique projections and shading. The students also make working drawings in connection with their practicum in mechanic arts. During the Junior and Senior years, the course comprises mechanical and engineering drawing, copying from the flat and from models, topographical sketches and maps, isometric and plane projections, plotting surveys and triangulations, lettering, map-drawing, coloring, and shading.

8. MECHANIC ARTS.

This course was begun about six years ago, but was afterwards greatly extended, and went into full operation in September, 1884. A substantial and attractive new building was opened February 10th, 1886, and is admirably adapted to its purpose. The course is designed to afford such students as have had the ordinary common-school education an opportunity to continue the elementary scientific and literary studies, together with mechanical and free-hand drawing, while receiving theoretical and practical instruction in the various mechanical arts.

The instruction in shop work is given by means of exercises so planned as to cover, in a systematic manner, the operations in use in the various trades.

The object of the course being to give instruction in the use of tools, only such constructions are made as cover principles without undue repetition.

The first instruction in carpentering and joining is in the use of the saw and plane in working wood to given dimensions, and a series of elementary exercises follow in order, such as practice in making square joints, different kinds of dove-tails, the various tenons, roof-trusses, panels, &c.

The instruction in turning and circular-section pattern-making is given from a series of models; also, bench-patterns are made for subsequent use in the foundry.

The foundry course consists in casting from the patterns which the student himself has previously made. Many of the pieces cast from these patterns are used in his clipping and filing work.

In the forge-shop, are taught the management of the fire and the degree of heat necessary to forge the different metals.

Drawing, forming, bending, upsetting, fagoting, splitting, punching, chamfering, annealing, tempering, case-hardening, &c., are taught by means of a series of exercises in which the elements of the iron-forger's art are particularly dwelt upon. Every piece is made to certain dimensions laid down upon the drawing, the article being forged before the class by the instructor, who directs attention to the essential feature of the operation, which is then repeated by each student.

The course in vise work includes filing to line, filing to template, free-hand filing, fitting, and chipping straight and grooved surfaces in cast-iron, wrought-iron, and steel.

In the machine-shop, the student, after having the lathe and its mechanical construction explained to him, is taught centering, tape-turning, chucking, reaming, inside and outside screw-cutting, bolt-turning, &c. He is then required to construct some piece of mechanism in which many of these principles are involved.

The drawing of this course extends through the entire three years.

This work is looked upon as of the highest importance, and the effort is to make the instruction thorough, practical, and of direct utility. Considerable time is devoted to free-hand drawing, as it is believed that it not only assists in mechanical drawing, but it is of great service in after years, whatever the occupation chosen.

The mechanical drawing consists of a series of exercises, and such are selected as will be of subsequent use. They are arranged in progressive order, beginning with geometrical constructions involving straight lines and circular arcs only, and ending with the more complex curves, such as the ellipse, helix, epicycloid, &c.

Projection is next taken up. The instruction in this is from models, so that the student may have before him the actual object from which the projection is made, and not be obliged to depend upon his unaided conception. After completing this work, he is required to draw parts of machines from actual measurements. For this purpose, he is given some piece of mechanism to sketch and measure, and of which, finally, he is to make complete working drawings.

The mathematical instruction of the course covers Algebra, Plane and Solid Geometry, Plane and Spherical Trigonometry, and Land Surveying, taught with special reference to this class of students, many practical applications being made. At present the department is well equipped, but additions of machinery are being made, from time to time, to meet the requirements of the course.

9. Mechanical Engineering.

The object of this course is to prepare students in those subjects which will enable them to design machines or plants of machinery upon scientific principles.

The instruction is given by means of lectures and recitations, with practice in the shops and laboratories. It treats of the mechanical properties of materials, of the motions and efficiency of machines, of the production, measurement, and distribution of power.

Excursions are occasionally made in order that students may witness running machinery, methods of carrying power, arrangement of shafting, and manufacturing processes.

The study of steam engineering involves the principles and applications of Thermodynamics, the characteristics and use of different fuels, the generation of steam with the construction of generators, and the mechanism and efficiency of the

various steam engines. Students are also required to design different forms of valve gearing from data given them.

Instruction is given on hydraulic motors, windmills, pumps, air engines, and other machines.

Drawing is carried on in connection with recitations. It includes sketching machines and drawing to scale from those sketches, making detail and sectional drawings, and designing machines, thus applying the principles and knowledge acquired in the class-room. The entire work is made as practical as is consistent with a thorough theoretical training. A course in shop work is required, besides the experimental work with boilers, indicators, inspirators, governors, testing strength of materials, &c. At the close of the course each student presents a thesis, in which he is to give evidence of his efficiency by explaining and illustrating some work of original research, or by designing and describing with plates some piece of mechanism.

14. PRACTICUMS.

Repeated mention has been made of the subject of *Practicums* as forming an important part of the educational work of the College, and several of them have been described in connection with the departments. Two others, on account of their special features, require separate mention.

(a.) MECHANIC ARTS.—This practicum (in distinction from the full course) has been in operation six years, and comprises a course in wood-working (in which are learned, among other things, the making of plane surfaces, correct angles, good joints, and the care and use of tools) and a course in forging, metal-working, &c.

Some may think that the variety of operations in the mechanic arts is so great as to make it impossible to give the student any real knowledge in the time at his disposal. It should be borne in mind, however, that this multiplicity of processes may be reduced to a small number of manual operations, and the numerous tools employed are only modifications of, or convenient substitutes for, a few tools which are in general use. The uses of the lathe are, to a great extent, the same, whether the material is bone, metal, or wood; whether the moving power be derived from the workman's foot, from the water-wheel, or from a steam-engine. Again, as fitting depends on a correct eye and manual skill, he who has learned to fit in metal by means of the clipping hammer and the file will not long find difficulty in fitting wood by means of the saw, the plane, and the chisel.

Mastery over a few processes and a few tools of universal application, acquaintance with the methods of fitting and finishing, and with the ordinary means of transmitting and converting power, are, then, the essential points embraced in this course. This practicum is required of all male students, at some stage of their course, but those who wish to devote themselves exclusively to this line of work and study can now enter upon the regular course of three years.

(b.) SURVEYING.—Although a professional art, surveying affords so much practice in the application of mathematics, and is of so frequent practical use, that its principles are valuable to the general, as well as to the *technical*, student. It is, therefore, required of all students during the Fall session of the Sophomore year. Surveys are made with the chain, compass, and transit; and from the data so obtained, plots are made and areas calculated. Triangular and trilinear surveying, laying out and dividing up land, and leveling complete the general course. In the Engineering Course, this training is far more extended.

Tuition is free, both in the Preparatory School and in the College; both of which are open to pupils of both sexes. There are also fifty free scholarships, one for each Senatorial district in the State, the holders of which are exempt from all the other College charges for room rent, furniture, etc.—

The catalogue of 1886–'87, gives a list of 72 students in the College and 63 in the Preparatory School. Ten of the College students are girls, and there are 13 girls in the Preparatory School.

The list of Faculty and Instructors, gives eleven Professors in the College, with two instructors. The Preparatory School has a faculty of four teachers; a Principal, and a lady professor, and two instructors.

The latest catalogue * at hand, shows the continuous growth of the College, as follows:

Within the last four years the College has greatly enlarged its facilities for instruction by the erection of new buildings, the reconstruction of old ones and the purchase of a large amount of equipment for several of the leading departments.

The Botanical Department.
The Chemical Department.
The Department of Physics and Electrical Engineering.
The Ladies' Department.
The Military Department.
The Agriculture Experiment Station.

The six departments recorded above have each been provided with commodious and attractive buildings, designed and built with special reference to their adaptation to the needs of these several branches of work. The drill hall of the military department has also been fitted up for use as a gymnasium, with the Sargent system of movable apparatus. A building for the accommodation of Mechanical Engineering and Civil Engineering, is already planned; and will be erected as early as possible.

The College is thus prepared to carry on its several branches of work more efficiently and successfully than ever before, and every effort is made to provide this large increase of additional facilities without any considerable increase in the expenses of students.

The following addition has been made to the course in Graphics:

During the present year, provision has been made for special instruction in Industrial Art and Design, with a view not only to introduce this branch of Drawing as far as practicable into all the courses of study, especially the Technical courses, but to provide a distinct department of training for those who wish to study Art in its applications to Industry or to find a career of life-work in this field.

The course begins with drawing from the object, as, geometrical solids, casts, plants, furniture, etc., passing as early as possible to processes which awaken the inventive faculty and cultivate the habit of original expression by means of form and figure instead of words. Special attention is paid to the applications of the artistic elements to commercial products, wall paper, oil cloth, wrought iron, etc., and it is believed that this may prove an opening to agreeable and remunerative employment for young women in particular.

The announcement is made that the course in Agriculture has been recast, to adapt it to the present requirements of science and practice.

The aim in the course in Agriculture is to teach how the principal branches of physical and natural science are applied to the business of farming, and to afford a thorough and comprehensive knowledge of its principles and methods.

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* Catalogue of the Pennsylvania State College, 1890–'91, State College, Centre County, Penna., 1891. Pp. 84.

Drawing is a required study in the first term of Freshman year. The catalogue shows a small number of students in the department of Agriculture.

The admirable report on Industrial Education, made in 1889, to the Legislature, by the Commission, of which President Atherton was chosen chairman, has been already fully noticed in the present Report. (See Part II, page 1225, *et seq.*) It is by similar contributions to educational literature, as well as by their services in guiding the education of youth, that the able body of educators connected with these colleges, serve the community at large, and add dignity and honor to their country.

The catalogue, shows a total attendance for the school year 1890–'91, of 209 students. Of these, 83 were in the Preparatory Department. Fifteen of the "college students" and nine of the "Preparatory," were girls.

The "Faculty and Instructors", comprise twenty-eight Professors and Instructors.

George W. Atherton, LL. D., is President, and Professor of Political and Social Science.

Brown University, Providence, R. I.

Was designated by the Legislature to receive the National land Grant and in 1863, made provision to carry out its conditions. The catalogue of 1881–82, thus states this condition.

Scholarships of the Department of Agriculture.—By resolutions of the General Assembly of the State of Rhode Island, the national grant, "for the benefit of Agriculture and the Mechanic Arts," was given to Brown University; and the fund of fifty thousand dollars, which has accrued from this grant, is by agreement on the part of the University devoted to the education "of scholars, each at the rate of one hundred dollars per annum, to the extent of the entire annual income." Appointments to these scholarships are made, on the nomination of the General Assembly, by the Governor and Secretary of State, in conjunction with the President of the University.

DEPARTMENTS OF PRACTICAL SCIENCE.

Departments of Practical Science have been established in the University for the benefit of students who wish to prepare themselves for such pursuits as require especially the knowledge of mathematical and of physical science, and their applications to industrial arts.

In these departments provision has also been made for courses of instruction in "such branches of learning as are related to Agricultural and the Mechanic Arts." This provision has been made in accordance with an "Act of Congress granting lands for the establishing of Agricultural Colleges," and with "Resolutions of the General Assembly of the State of Rhode Island, accepting these lands, and assigning the same to Brown University." Students who enter only for these studies, either in full or in part, are subject to the same conditions of admission as for any select course; and when they have duly pursued such studies, they will be entitled to a certificate stating the time of their University residence, and the amount of their acquisitions. They may, however, pursue these studies in connection with "the regular scientific and classical studies of the University," and when they have

so pursued them as to fulfill the requirements for the degree of Bachelor of Arts or of Bachelor of Philosophy, they will be entitled to these degrees.

These Departments are "Chemistry applied to the Arts;" Civil Engineering; Physics; Botany; Zoology and Geology; Agriculture.—As drawing is especially taught in Civil Engineering, the progress of the course in this department is given.

CIVIL ENGINEERING.

The regular course in this department occupies four years, but a longer or shorter course may be pursued, according to the wants or abilities of students. Those who are unable to pursue a full course, will find the studies so arranged that the knowledge and practice acquired in only a partial course will be practical and available. Ample provision will be made for the instruction of any who desire a more extended course than is here indicated, in Engineering and in Higher Mathematics.

The following is the order of study for the regular course:

First Year. Use of Mathematical instruments, including Line drawing, Pen shading, Graphical construction of Plane problems; Free-hand drawing and shading; use of Mathematical tables; Trigonometry, and its application to the measurement of areas; Plane surveying, including the theory and adjustment of instruments, Field practice, Plotting surveys, and descriptive Geometry.

Second Year. Differential and Integral Calculus; Shades and Shadows and liner Perspective, and Isometrical Drawing.

Third Year. Theory of structure, embracing the construction of foundations, Stone and Brick masonry; and detailed drawings of the same; Calculation and geometrical representation of the strain on trusses and girders; Drawing of Plans, Profiles, Elevations, and Sections.

Construction of machinery and bridges, and drawings of the same; strength of materials used in construction; Estimation of resistance of Friction and rigidity; and Hydraulics, embracing the structure and use of hydraulic machines, the investigation of the laws which govern the flow of water from reservoirs and the flow of water in rivers, canal and conduit pipes, and water used as a motor.

Fourth Year. Weisbach's Mechanics, or Mahan's Civil Engineering.

To pursue this course to the best advantage, the following mathematical studies taught in the University, should be pursued in connection with those above mentioned, viz: Algebra, Geometry, Plane and Spherical Trigonometry, Analytical Geometry, and Calculus.

Students desiring admission to this course are subjected to an examination on the same amount of Mathematics as is required of candidates entering for a degree.

In Botany, "free use is made of the black-board and diagrams, and great stress is laid upon the importance of drawing from nature, and students are taught to make illustrative sketches."

Two courses of four years study, are arranged for those desiring to study for the Degree of Bachelor of Philosophy; the first includes one ancient language, the second does not. In these courses, drawing is an essential study. Mechanical drawing, 2 hours a week, freshman year, is required in the first Mechanical course; and free hand drawing, 3 hours a week, in the second course.

In first Mechanical course, "Shades and Shadows," 3 hours a week, first half of the Sophomore year. In second Mechanical course "Shades and Shadows," three hours a week; and Linear Perspective,

two hours a week, first half of Sophomore year. Both courses take "Civil Engineering," 2 hours a week in Junior year, also in Senior year.

Thirty-six students took the course of Civil Engineering, in 1880. The catalogue of the University for 1881–82, gave a total attendance in all the classes of 251 students.

From the first annual Report of the Board of Managers of the State Agricultural School and Experiment Station,* it appears that, as far back as 1869, there had been dissatisfaction with the Agricultural department of Brown University; since the State Board of Education, in their report of that date, from which the Board of Managers quote, stated that they "are of the opinion that the intentions of Congress have not been carried out in good faith by either Rhode Island, or Brown University."

In 1872, a legislative committee expressed dissatisfaction with the action of the College in respect to the Land Grant Fund. In 1884, the Legislature changed the sum allowed to the College for "State pupils," from $100 to $75.

In 1888, the Legislature, acting on the report of a joint special committee appointed to recommend action in reference to the act of Congress establishing Agricultural Experiment Stations, established a State Agricultural School in the town of South Kingston.

A farm containing 140 acres, was bought for $5,000. The town of South Kingston, contributing $2,000; Friends $2,000 more; and the State, the additional $1,000.

In May, 1889, the Board as stated in their second report;† elected as Principal of the school John H. Washburn, B. SC., PH. D., a graduate of the Massachusetts Agricultural College, and then studying at Göttingen, Germany, where he received the degree of PH. D.—

Dr. Washburn, in his report to the Board, gives in detail, the programme of a course of three years of study. Drawing in each year, wood work, and iron work, are included; work in iron, only in the Senior year.

The following extracts show, in part, the plan of the School.

DESIGN OF THE INSTITUTION.

It is our purpose to have a School which is first class in all its departments, to fit

* First Annual Report of the Board of Managers of the Rhode Island State Agricultural School and Experiment Station, made to the General Assembly, at its January session, 1889. Providence: E. L. Freeman & Son, State Printers. 1889. Pp. 27.

† Second Annual Report of the Board of Managers of the Rhode Island State Agricultural School and Experiment Station, made to the General Assembly at its January Session, 1890. Part I. State Agricultural School. (Part II. State Agricultural Experiment Station is printed under separate cover.) Providence: E. L. Freeman & Son. Printers to the State. 1890. Pp. 20.

young men who intend to pursue agriculture or the mechanic arts, for active life, to educate them in the branches of Agriculture and in other knowledge such as is necessary to develop their manhood and instruct them in the duties of good citizenship.

It is very difficult at the present time for a young man to find a place to learn a trade. The carpenters and machinists will not take the trouble to teach a young laborer. When he can do one thing well, he is made to do that and nothing else, because he turns off work faster and as a factor in production, is more valuable to his employer. The industrial schools which are being founded throughout this and all other civilized countries, are intended to obviate this distressing difficulty. Such an institution of instruction which has for its object the education and training of both mind and hand, is the most complete that can be devised; already rapid strides have been made in the great work of industrial education, and the experience of competent educators in this direction has been that the pupil learns as much, and in some cases more, theory with, than without the additional knowledge of the practical manipulation of tools. A young man going out into the world from an industrial school has a great advantage over those young men who have had very little schooling, he is educated and becomes an active man in public and private affairs. Industrial legislation has been and will continue to be forced upon our legislators. The trades must not remain in the hands of the ignorant. That the working men in many cases have not received justice is an indisputable fact, that many persons in these labor reforms become excited over one idea and do not know when they receive justice, is quite as indisputable a fact. They lack education to balance their minds. It is doubtless a potent factor in the solving of our labor troubles, *to educate the laborer himself*. That, and that alone can bring to us a peaceful solution of our social troubles.

Special attention is given to manual labor in our school and it is the desire of our faculty to have all agricultural and other labor which is performed as a class exercise, *educative*. Our entrance examination is within the easy reach of any pupil of ordinary intelligence from our district schools. We hope that the many boys of our country schools will be able to avail themselves of the rare privileges which we will offer to worthy young men who are striving for an agricultural and industrial education.

The special advantages of such an institution as we hope to make this one, extend into every community, not only to the agricultural but we might almost say especially to the manufacturing and industrial communities.

In the ever increasing circulation of men from country to city and from the city back again to the country, a school of this kind will teach the young man from the city the progress and improvements which have been made in agriculture. He can understand the best methods which are being successfully used in the special branch of agriculture he intends to pursue, and at the same time he becomes acquainted with the practical manipulation of farm labor and management. Our industrial department will teach those young men not fitted to become farmers that special line of work to which they are adapted.

The commission, appointed by the Legislature to confer with Brown University, in relation to the so called Agricultural Fund; made to the January, 1892, session of the Legislature, a "majority" and "minority" Report. To the first, a proposition from the University to adopt the school as a department of the University, is appended; to the Minority report, is appended a resolution calling on the University to give back to the State, the 1862 Land Grant Fund.

No final action has taken place.

In the latest annual report* at hand, the President, urges that this college should prepare itself to undertake "University work," in its highest sense. He predicts that, in the near future, a few institutions will advance to the higher work of original investigation, which is the province of a true University, leaving the work of direct instruction of undergraduates to the majority of existing institutions, which will remain simply colleges; confessedly of lower rank in the hierarchy of educational institutions. In other words, he thinks the standards of modern scholarship, and the requirements of a liberal education, have been so uplifted and specialized, that the ordinary degrees, of "B. A." and "A. M.", no longer represent the relative quality and amount of scolarship with which they were formerly accredited. He points to the great increase in the number of Post Graduate students in the various Institutions, as confirming his position.

He explains that the difference between a College, and a University, does not consist, as is commonly assumed, in the fact that a number of schools of the so called "Learned Professions" are grouped with the latter. In fact, he argues that a true University, may exist without association with, or direction of, a single one of the old professional schools of Theology, Law, and Medicine.

The opportunity for original research; a body of Professors who have won distinction by devoting themselves to such research; with ample facilities in Libraries, Museums, and Laboratories, for illustrating and prosecuting such researches; and, with all, a number of endowed Fellowships, to attract and support such capable students as may evince peculiar aptitude for such studies and investigations; these, are the essential requisites and characteristics of a true University. For all these purposes large additional endowments are needed; and he appeals to the Alumni of Brown, to enable their University to advance by so endowing it;—under penalty, otherwise, of seeing it retrograde.—The President advocates, also, the free admission of women students to all the Post Graduate courses.

The reports made by the several Professors, to the President, accompany this report. In that by the Professor of the course in "Mathematics and Civil Engineering," it is stated that "courses in Machine Drawing and Gearing, were offered this year for the first time."

In the Department of Physics, the following instruction in Manual Training was given:

During the entire college year, the workshop has been open to students, under

* Annual Report of the President to the Corporation of Brown University June 23, 1892. The Providence Press: Snow & Farnham, Printers, 37 Custom House Street. 1892. Pp. 70.

the direction of Mr. Mount, assisted by Mr. Lester in the wood-working, and by Mr. Burdick in the machine department. The attendance was as follows:

First term	43
Second term	36
Third term	16
	95

The time devoted to workshop practice by each student was six hours per week.

In Agriculture. The usual course of lectures on Agricultural subjects was given to the fourteen members of the Senior Class, who were beneficiaries under the conditions of the State Agricultural Scholarships.

The latest catalogue* at hand, gives a concise historical statement of the movement which resulted in the founding of the college in 1764, and reprints, with all its quaintness of expression and typography, the original charter, authorizing certain persons named therein to found a college, or university. In 1770, the college, which had first opened in the town of Warren, was moved to Providence, and in 1804, was, by vote of the corporation, named Brown University; in recognition of the beneficence of Mr. Nicholas Brown.

The following account gives a general outline of the plan and method of the instruction offered to undergraduates at the present time.

THE COURSES OF INSTRUCTION.†

The courses of instruction for undergraduates form a system of studies partly required and partly elective. The studies of the Freshman year are nearly all required, the main exception being that candidates for the degrees of Bachelor of Philosophy have a choice of courses according as they do or do not wish to pursue the study of an ancient language. The required studies of the Freshman year are selected for their disciplinary value, that the students may the more profitably pursue those, whatever they may be, of the subsequent years. During the last three years large liberty in the choice of studies is allowed, particularly in the case of candidates for the degrees of Bachelor of Arts and Bachelor of Philosophy. In the Sophomore and Junior years of the courses for those degrees the required studies occupy seven of the sixteen hours of instruction each week, and in the Senior year three of the fourteen hours. The required studies for these degrees during three years are restricted to English, German, History and Philosophy, the pursuit of which is deemed necessary for every student who is to receive a collegiate degree. Candidates for the degree of Bachelor of Science and Civil Engineer are allowed less freedom of election, in order that they may thoroughly master the branches necessary for the most thorough discipline in their respective departments.

The elective studies, which are very numerous, are so placed in the curriculum as to give all those entitled to this all the freedom of choice which the necessary limitations of the schedule of lectures admits. In arranging this schedule a number of parallel courses, each unitary and progressive and extending through the three years are made available. Every student is advised in selecting his studies to adopt in the main one of these courses.

*Catalogue of the Officers and Students of Brown University 1891–'92. The Providence Press: Snow and Farnham, Printers, 37 Custom House Street. 1892. Pp. 167.

†Instruction for graduate students is treated by itself in a later paragraph. Also, a special circular relating to the same may be had on application to the Register.

In addition to the regular courses of instruction, special honor courses are offered, which are open to students willing to do large extra work in their particular departments. These honor courses, fully described in a later paragraph, mainly consist of special reading supplement by problems and essays. Examinations in them are held at the option of the several professors.

The following programme of instruction in Drawing, is given under the course in Applied Mathematics.

XII. APPLIED MATHEMATICS.

* * * * * * *

DRAWING.

Professor Randall.

1. *Elementary Mechanical Drawing.*—Four hours. First term. Elective for all students.

2, 3, 4. *Freehand Drawing.*—One hour. First, Second, and Third Terms, respectively. Elective for all students.

5, 6. *Descriptive Geometry.*—Church's Descriptive Geometry, Mechanical Drawing. Four hours. Second and Third Terms respectively. Elective for those who have taken Course I.

7. *Shades, Shadows, Perspective and Isometrical Projections.*—Davies's Shades, Shadows and Perspective. Church's Shades, Shadows and Isometrical Projections. Burchett's Perspective and Davidson's Perspective. Three hours. First Term. Elective for those who have taken Courses 1, 5 and 6.

8. *Mechanical Drawing.*—Application of the principles of Descriptive Geometry to machine drawing from models. Three hours. Second Term. Elective for those who have taken Courses 1, 5 and 6.

9. *Mechanical Drawing.*—Construction of Higher Curves and their application in the formation of Gear Teeth. Third Term. Three hours. Elective for those who have taken Courses 1, 5 and 6. Additional courses in Mechanical Drawing will be offered in subsequent years to meet the needs of advanced students.

The Manual Training Course comes under the general course in Physics.

Work-shop Course in Mechanical Processes. Training in the use of tools for working wood and metals. Three hours [six hours' attendance in shop]. First and Second Terms respectively. Elective for Sophomores, Juniors and Seniors, but pupils applying for this Course are required to take Mechanical Drawing also.

By special permission work-shop practice may be continued for more than one term, but only a single term will count toward the attainment of a degree.

In the general description of the Courses of Instruction, Drawing comes in the regular course of Civil Engineering, as follows:

2. Mechanical Drawing, consisting of instruction in the use of instruments, discussion, proof, and application of the methods of constructing Plane Geometrical Problems and the more complicated Plane Curves, flat and graduated Tinting, the principles of Orthographic and Isometric Projections, and their application in Model Drawing.

3. Free-hand Drawing, consisting of pencil drawings of models, introducing the principles of Orthographic Projections, Shades, Shadows, and Perspective. At present this subject is taught as subsidiary to Mechanical Drawing, and the aim is to enable students to make hasty but intelligible machine sketches which may be used as guides in the more accurate drawings which follow.

4. Descriptive Geometry, consisting of the discussion and proof of the various methods of constructing a large number of problems, with extensive and accurate application of these methods in the Drawing Room.

Second Year. 1. Elementary Mechanics embracing the fundamental principles of Mechanics, treated from a mathematical point of view, with such experiments as are necessary to illustrate principles.

2. Analytical Geometry as indicated on page 64.

3. Shades, Shadows, Perspective, and Isometric Projections, comprising recitations and mechanical drawing based on the principles of Descriptive Geometry.

4. Mechanical Drawing, consisting of free-hand sketching, detail and assembled drawings of machines, and the study of the theoretical and practical methods of constructing gear teeth. Lectures and drawing.

* * * * * * *

The objects sought in Mechanical Drawing are:

1. To prepare the students for the duties of the Draughting Room by bringing before them a large number of theoretical and practical problems which shall involve the principles most needed in the work of the present time.

2. Discipline of the mind through the discussion and proof of original methods of solution.

3. To encourage neatness and accuracy and develope the power of concentration without which the work of the Draughting Room cannot be acceptably done.

* * * * * * *

Wilson Hall, recently completed, is well constructed and equipped for its purposes as a Laboratory for the experimental study of Mechanics and Physics.

The Workshop and the Physical Laboratory are open to students five days in the week, from 9 A. M. to 6 P. M.

The course in the Workshop is offered to those who have mechanical tastes and aptitudes but may not wish to pursue courses in the mathematics of the subject.

The announcement of the "Department of Instruction" especially related to the Land Grant Fund, is here given in full:

XVIII. Agriculture and the Mechanic Arts.

An extended course of study in Agriculture and the Mechanic Arts is open to all students. It includes the courses offered in the departments of English, Political Economy, Mathematics, Engineering, Chemistry, Physics, Zoölogy, Geology, Physiology and Botany, as given above, and also special lectures on Agriculture. These relate to the study of soils and to applied Economic Zoölogy, according to the following schedule of topics:

Introduction: History of Agriculture, tracing its development through the Jewish, Grecian, Roman, Spanish and English nations to the formation of agricultural and horticultural societies in the United States, with a brief account of the earlier of these formed within the years from 1785 to 1829 inclusive. The subject is then continued by the discussion of the following topics:

I. Primary Condition of Matter. II. Formation of Soil from Inorganic Elements. III. Source of Organic Matter. IV. Constituents of Plant required by Soil. V. Constituents of Soil in the Mass. VI. Composition of Fertile Soil. VIII. Cardinal Law in Agriculture. IX. Rotation of Crops. X. Discriminating Application of Fertilizers.

Under the general head of Economic Zoölogy are discussed the distinctive characteristics of the most approved breeds of both neat cattle and horses. Practical instruction is given by the visiting of farms and in obtaining and preserving specimens in Natural History. Taxidermy is also taught when desired by the class.

The above course is arranged in pursuance of the agreement entered into between

the Corporation of Brown University and the General Assembly of the State of Rhode Island in January, 1863, by which the University receives the benefits of the Act of Congress approved July 2, 1862, entitled "An Act donating Public Lands to the several States and Territories which may provide Colleges for the Benefit of Agriculture and the Mechanic Arts."

The University Art Collections, possess a number of interesting portraits; which are, from time to time, added to by the Alumni. A beginning has also been made of a Museum of Classical Archaeology.

A collection of classical casts,—selected by the late Professor Lincoln, for Henry Kirke Porter, Esq., of Pittsburg, Penn., of the class of 1860, who gave them to the University,—was the beginning of what gives promise of becoming a valuable Museum of Ancient Art. The utility of such a collection of casts in illustrating classical literature, and as models in drawing, is readily seen.

Professor W. C. Poland, associate Professor of Greek, is Curator of the Museum of Classical Archaeology. The following statement shows the students in attendance during 1891–'92.

SUMMARY.

Graduates	35
Seniors	59
Juniors	67
Sophomores	94
Freshmen	102
Select Course	26
Total	403

The "Faculty and other Officers" of the University number Fifty-two. Rev. Elisha Benjamin Andrews, D. D. LL. D., is President and Professor of Moral and Intellectual Philosophy.

University of South Carolina.

The South Carolina College of Agriculture and Mechanics, at Columbia, South Carolina; was established by the Legislature in accordance with the provisions of the law passed March, 22, 1878.

The following sections of which, are quoted from the 27 sections of the bill.

An Act to Provide for the Organization of the State University.

Section I. *Be it enacted* by the Senate and House of Representatives of the State of South Carolina, now met, and sitting in General Assembly, and by the authority of the same. That the University of South Carolina shall be, and it is hereby divided into two branches—the one located in the city of Columbia, and styled the South Carolina College, and the other in or near the town of Orangeburg, to be styled the Claflin College; and that the said University, and both branches thereof, shall be, and are hereby, placed under the control and management of the Board of Trustees of the University of South Carolina, now in office, and their successors elected according to law.

Sec. 2. That the Board of Trustees shall consist of the Governor of the State for the time being, the State Superintendent of Education, the Chairman of the Com-

mittee of Education of the Senate and House of Representatives for the time being, and seven persons to be elected on the joint vote of the General Assembly, who shall hold their offices for a term of four years, and until their successors shall be appointed, no one of whom shall be in any other manner connected with the University. * * * *:

Sec. 10. That all property, real or personal, rights of property and credits, belonging or appertaining to the Agricultural College, shall vest in and become the absolute property of the University of South Carolina, to be used and enjoyed solely for the purpose for which such property and credits were originally given. * * * *.

Sec. 20. There shall be admitted into each College of the University one student from each County of the State, who shall be entitled to tuition free of charge; such student shall be appointed by the Governor, upon the recommendation of the delegation in the General Assembly from the County in which the applicant resides, and after a competitive examination: *Provided*, Such applicant shall show upon examination before the Faculty the degree of proficiency required of other applicants for admission in said College, and be otherwise eligible for admission in said College.

The State, having some years previously accepted the National land grant in aid of "Agricultural and the Mechanic Arts," and some questions arising in relation to the legislation in regard to it, by act of December 23d, 1879;—two sections of the law are here quoted.

AN ACT to Provide for the Investment and Use of the Agricultural College Fund.

SECTION 1. *Be it enacted* by the Senate and House of Representatives of the State of South Carolina, now met and sitting in General Assembly, and by the authority of the same, That in accordance with the stipulations entered into with the United States by this State accepting and receiving the donation of land scrip for the endowment of one or more colleges for the promotion of agriculture and the mechanic arts, the State Treasurer be, and he is hereby, authorized and required to issue to the Board of Trustees of the University of South Carolina a certificate of State stock in the sum of one hundred and ninety-one thousand eight hundred ($191,800) dollars, bearing interest at the rate of six per cent. per annum from July 1st, A. D. 1879, payable semi-annually, to be held by the University of South Carolina as a perpetual fund (capital of which shall remain forever undiminished), to be used by said Board of Trustees solely for the purposes for which the said land scrip was originally donated by the Acts of the Congress of the United States in relation thereto; the said certificate of stock to be held in lieu and stead of the Agricultural College bonds, formerly constituting the Agricultural College fund under the said Acts of Congress and the Acts of the General Assembly of this State in relation to the same, and heretofore used by the Financial Agent for general State purposes.

Sec. 2. That the Board of Trustees of the University is hereby authorized to establish a College of Agriculture and Mechanics for the benefit of the white students, in addition to the South Carolina Agricultural College and Mechanics' Institute now in operation for the benefit of colored students, and to maintain the said colleges out of the income of said fund, and to use the property and grounds of the University of South Carolina at Columbia in such manner and so far as deemed necessary for the purpose aforesaid.

The third and final section authorizes the founding of scholarships under certain conditions.—

The University, thus revived in Columbia under the name of the

South Carolina College of Agriculture and Mechanics, opened its first session October 5, 1880.—

Dr. Miles, the President, in showing the facilities for obtaining instruction in Agriculture and the Mechanic Arts says:

"For enabling our students to acquire practical acquaintance with planting and farming, and the methods of cultivating our staple crops, we have an ample area of land, where Mr. Connors, our farmer, an experienced and skilled agriculturist, gives his undivided attention to field and garden operations. Here the lectures on Agricultural Chemistry are supplemented and illustrated by the test and comparison of various fertilizers on growing crops. * * *.

Mr. Jesse Jones a thoroughly skilled and unusually ingenious mechanic and machinist, is our master mechanic and has charge of the work-shop, where, under his eye, the student learns the use of all ordinary tools and how to handle them, and how to plan and construct farm buildings, and to make and repair farming implements, &c., and where gradually, a practical acquaintance with engines, mills, and machinery generally, may be acquired.

A three years course of study is adopted. The School of Mathematics embraces two distinct departments. 1. Pure Mathematics, and 2. Applied Mathematics. All instruction in drawing comes in the second department and is given in the 2nd year, when Descriptive Geometry, Shades and Shadows and Surveying are taught, and in the 3rd and senior year, when Civil Engineering is taught. Total number of students for 1880–'81, was 60.—

The catalogue for 1890–'91,* begins with a concise history of the various changes that have been experienced by this State Institution during the political vicissitudes of the Century; followed by a brief outline of the existing organization of the University at Columbia, which, as they show the scope of the University as a whole, are here given.

HISTORICAL STATEMENT.

The South Carolina College was chartered by the General Assembly in 1801, and threw open its doors to the youth of the State in January, 1805.

It continued in successful operation down to July, 1863, when its buildings were taken possession of by the Confederate Government and used as a hospital until the close of the war.

Its charter was amended by the Legislature in 1865, and in 1866 it was reopened as the University of South Carolina.

It was again closed in 1876, in consequence of the unsettled political condition of the State.

In 1878 the charter was again amended, and the University divided into two branches—the one situated at Columbia styled the South Carolina College, the other, situated at Orangeburg, Claflin College. (In 1882 a third branch was added, the State Military Academy at Charleston.) No immediate steps were, however taken to reopen the College.

In 1879 the Trustees of the University were empowered by Act of the General Assembly to establish a College of Agriculture and Mechanics at Columbia, and to use the property and grounds of the College for this purpose. This was accordingly done in 1880.

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*Catalogue of the University of South Carolina, 1890–'91. Columbia, S. C. Printed at the Presbyterian Publishing House, 1891. Pp. 84.

In 1881 the Legislature granted an annual approriation for the support of the schools of the University, and in 1882 the South Carolina College was reorganized by the appointment of a full Faculty. It went into active operation the fall of the same year.

In December, 1887, the charter was, for the third time, amended, and the University re-established at Columbia, with branches, as heretofore, at Orangeburg and Charleston. In October, 1888, the University was reopened with the following departments: Graduate Department, College of Liberal Arts and Sciences, College of Agriculture and Mechanic Arts, College of Pharmacy, Normal School, Law School.

OUTLINE OF ORGANIZATION.

The University at Columbia comprehends the following departments: The Graduate department; the College of Agriculture and Mechanic Arts; the College of Liberal Arts and Sciences; the College of Pharmacy; the Normal School; the Law School.

In the Graduate Department, graduate courses, either in special departments of nstruction or in groups leading to the higher degrees, are provided for graduates of this University, or other institutions of similar rank, who wish to pursue advanced studies.

The College of Agriculture and Mechanic Arts offers five full courses for degrees, of four years each, one general and four technical—the course of General Science, the course of Civil Engineering, the course of Mechanical Engineering, the course of Chemistry, and the Course of Natural History.

For students unable to go forward to degrees this College has arranged three special courses, of two years each—the shorter course of General Science, the shorter course of Applied Science, and the Business Course.

In the College of Liberal Arts and Sciences there are three degree courses, of four years each—the course of Classical Literature, the course of Modern Literature, and the course of History and English Literature.

The College of Pharmacy offers two courses, of two years each—one professional course in Pharmacy, leading to a degree, and the course preparatory for Medicine and Pharmacy, leading to a certificate.

The Normal School has two courses—a professional course of one year for teachers, and a course of two years, preparatory for the study of Pedagogy.

The Law School offers a coure of two years, leading to a degree.

Elective courses are also allowed under epecial circumstances.

Every matriculate is required, except in special case approved by the University authorities, to elect one of the full or special courses. The student is graded in each study of the course selected according to his preparation therein. The majority of his studies determine his rank. In each year of every course there are eighteen or more exercises a week and six or more distinct branches of study. With the consent of the proper authorities, other studies in addition to those prescribed in the course may be carried. One or more electives are allowed in the last two years of several of the courses. These provisions secure for the student the full benefit of his preparation in each study and give flexibility to the courses and system of gradation.

The following are the courses of study offered by the college of Agriculture and Mechanic Arts.

COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

COURSES OF STUDY.

I. Regular Courses for Degree of Bachelor of Science (B. S.)—Four Years Each.

I. FOR DEGREE OF BACHELOR OF SCIENCE—B. S.

1. Course of General Science.

First Year.—1st Mathematics; 1st History; 1st English; 1st French; 1st German; Free-hand Drawing.

Second Year.—2nd Mathematics; Surveying and Descriptive Geometry (each one term); 1st Physics; 2nd French; 2nd German; 2nd English.

Third Year.—3rd Mathematics; Structural Botany and Physiology (each one term); 1st Chemistry; Psychology; Zoology and Qualitative Analysis (each one term); Elective.

Fourth Year.—Mineralogy; Geology; Political Economy; Astronomy and Philosophy of Religion (each one term); Logic; Elective; Essays.

2. Course of Civil Engineering.

First Year.—1st Mathematics; 1st French; 1st German; 1st English; Wood Work; Free-hand Drawing; 1st Mechanical Technology.

Second Year.—2nd Mathematics; Surveying and Descriptive Geometry (each one term); 1st Physics; 1st Chemistry; French or German; 2nd English; 1st Mechanical Drawing.

Third Year.—3rd Mathematics; Spherical Trigonometry and Geodesy (each one term); Mechanics; 2nd Physics; Qualitative Analysis; French or German; 2nd Mechanical Drawing.

Fourth Year.—Civil Engineering; Civil Engineering Drawing; Thermodynamics; Mineralogy; Geology; Astronomy (1st term); Elective (2nd term); Essays.

3. Course of Mechanical Engineering.

First Year.—1st Mathematics; 1st French; 1st German; 1st English; Wood Work: Free-hand Drawing; 1st Mechanical Technology.

Second Year.—2nd Mathematics; 2nd Mechanical Technology and Descriptive Geometry (each one term); 1st Physics; 1st Chemistry; French or German; 2nd English; 1st Mechanical Drawing; Vice Work.

Third Year.—3rd Mathematics; Spherical Trigonometry and Principles of Mechanism (each one term); 2nd Physics; Mechanics; French or German; 2nd Mechanical Drawing; Machine Work.

Fourth Year.—Applied Mechanics; Thermodynamics; Mineralogy; Geology; Qualitative Analysis; Designing and 3rd Mechanical Drawing (each one term); Machine Work; Astronomy (1st term); Essays.

4. Course of Chemistry,

First Year.—1st Mathematics; 1st French; 1st German; 1st English; Free hand Drawing; Physical Geography.

Second Year.—2nd Mathematics; 1st Physics; 1st Chemistry; 2nd French; 2nd German; 2nd English.

Third Year.—2nd Chemistry; Chemical Technology; Qualitative Analysis; 2nd Physics; Mineralogy; Zoology and Physiology (each one term); Structural and Systematic Botany (each one term).

Fourth Year.—Quantitative Analysis; Volumetric and Organic Analysis; Geology; Applied Mineralogy; Assaying and Organic Preparation; Microscopy and Bacteriology; Essays; Elective.

5. Course of Natural History.

First Year.—1st Mathematics; 1st French; 1st German; 1st English; Free-hand Drawing; Physical Geography.

Second Year.—2nd Mathematics; 1st Physics; 1st Chemistry; 2nd French; 2nd German; 2nd English.

Third Year.—Qualitative Analysis; 2nd Physics; Zoology and Physiology (each one term); Free-hand Drawing; Structural and Systematic Botany (each one term); Mineralogy; Geology.

Fourth Year.—Applied Mineralogy; Applied Geology; Microscopy and Bacteriology; Quantitative Analysis; Elective and Hygiene (each one term); Free-hand Drawing and Entomology (each one term); Essays; Elective.

II. SPECIAL COURSES FOR CERTIFICATES.—TWO YEARS EACH.

1. Shorter Course of General Science.

First Year.—1st Mathematics; 1st English; 1st History; Physical Geography; Free-hand Drawing.

Second Year.—2nd Mathematics; 2nd English; 1st Physics; 1st Chemistry; Structural Botany and Physiology (each one term); Elective.

2. Shorter Course of Applied Science.

First Year.—1st Mathematics; 1st English; Free-hand Drawing; Wood Work; 1st Mechanical Technology; Physical Geography.

Second Year.—2nd Mathematics; 2nd English; 1st Physics; 1st Chemistry; Surveying and Field Practice; 2nd Mechanical Technology and Descriptive Geometry (each one term); 1st Mechanical Drawing.

3. Business Course.

First Year.—Commercial Arithmetic and Book-keeping; 1st English; Physical Geography; Phonography; Free-hand Drawing.

Second Year.—1st Mathematics; 2nd English; Phonography; Book-keeping, &c.; Elective.

III. ELECTIVE COURSES.

These are such as may be allowed under special circumstances, on application. Such application must show exceptional grounds, and, in case of minors, must be accompanied by written request of parent or guardian.

Note.—In addition to the studies included in the foregoing courses for degrees or certificates, laboratory courses are offered in Zoology and Physiology, and a course in Spanish. These can be taken as optional or elective studies.

It will be seen that drawing, in a greater or less degree, is included in each of these courses. In the course in Mechanical Engineering it forms a very essential feature. The following is the detailed statement of this course.

DEPARTMENT OF MECHANICAL ENGINEERING.

Professor Edwards. Instructor Niernsee.

In this department there are twenty-two classes—

First, Second, and Third Mechanical Drawing.—These classes meet three periods a week, of two hours each, the first two throughout the session, the third during one term.

First Mechanical Drawing.—The proper use and care of drawing instruments, construction of plane figures, the study of helical and other curves, the projection and sections of geometrical solids, shading, tinting, and conventional use of colors.

Second Mechanical Drawing.—The making of accurate working-scale drawings from measurements, and rough sketches of parts of machinery, and the drawing necessary in connection with the course in mechanism, and gear construction, with practice and tracing in blue printing.

Third Mechanical Drawing.—Detail and assembly drawings from machinery, followed by mechanism designs and boiler drawings. Machine design.

The classes in Free-hand Drawing meet three periods, of two hours each, throughout session.

First Free-hand Drawing.—Charcoal and crayon drawing from plaster casts of geometrical solids. Perspective drawing in pencil, illustrated by problems.

Second Free-hand Drawing.—"Antique" drawing from plaster casts of feet, hands, masks, and busts.

Third Free-hand Drawing.—"Antique" drawing from plaster casts of the human figure.

Fourth Free-hand Drawing.—"Life" drawing from the living model.

In addition to the foregoing, two special classes in Free-hand Drawing are formed in connection with course in Natural History. *First year.*—Blackboard drawing of diagrams and cuts for lecture illustrations, in colored chalks. *Second year.*—Anatomical studies, plant and insect forms from nature in pencil, pen and ink, and water colors.

Drawing is considered as a language, or mode of expressing ideas, and as being, therefore, not less important than linguistic study on account of its disciplinary as well as its direct practical value. As a language it is an intelligible mode of communicating thoughts and explaining things, having, moreover, this advantage over other languages spoken or written, that it is universal, that it is almost alike intelligible to all the diverse races of mankind, needing no translation, but at once "known and read of all men."

The exercises consist mostly in drawing directly from the objects. The student is expected to observe constantly the relation of the object to the mode of its representation, and to become self-directing, without wasting time in copying the delineation of others.

COURSES IN SHOP WORK.

First Shop Work.—This is a course in Wood Work, and consists in instruction in the ordinary carpenter's and pattern-maker's tools, and the performing of such operations as planing, sawing, trueing up, rabbeting, ploughing, mortising, tenoning, dovetailing, squaring, tonguing, cornering, dowelling, splicing—straight and scarfed, &c. Practice will be given in turning, scroll work, &c., with the scroll saw, and in such work as requires the use of other ordinary machine tools.

Second Shop Work.—This consists in the ordinary bench and vice work of machine shop, such as chipping, filing, drilling, use of taps and dies, and fitting in general. A portion of this year will also be devoted to forge work, such as welding iron and steel, tempering, making tools, bolts, nuts, &c. Brazing and soldering will be included in this year's work. Forge work will indirectly be continued through the last three years, as the student will be required to dress and temper his own tools.

Third Shop Work.—This is devoted to the various methods of moulding, and the commencement of a course in machine work.

Fourth Shop Work.—This, Machine Work, commenced the preceding year, consists in drilling, planing, boring, shaping, milling, turning, cutting screw-threads, etc. A knowledge of the different kinds of work that each tool is capable of turning out, will be given to the student either by his seeing in each case the work performed, or by his having charge of, or performing the work himself in as many instances as time will allow.

These four classes meet three periods of two hours each, every week during their respective years.

COURSES IN MECHANICAL TECHNOLOGY.

First Mechanical Technology.—This course covers the nomenclature of carpentry, pattern-making, and other kinds of wood work, the tools and appliances of each, the work to which each tool is adapted, the proper method of handling it, and the reasons for its peculiarity of construction, proper cutting bevels for edge tools, &c. This course runs parallel to, and is an adjunct to, *First Shop Work.* Text-book: Shelley's Work-shop Appliances. (This class meets once a week during session.)

Second Mechanical Technology.—This is a course similar to the preceding, but with machine work and the various tools and methods of the machinist as its subject. This course is preparatory to *Second*, *Third*, and *Fourth Shop Work.* Textbooks: Rose's Practical Machinist; Spretson's Casting and Founding; West's American Foundry Practice. (This class meets three times weekly during first term.)

COURSES IN MECHANICS.

Mechanics.—In the first term of the year given to this study, Elementary Mechanics will be taken up and finished. During the second term will be discussed all of Mechanics properly understood only with the aid of calculus, such as the determination of volumes, areas, centres of gravity, pressure, &c. Text and reference books: Todhunter's Elementary Mechanics; Smith's Mechanics; Mosely's Mechanics; Wood's Analytical Mechanics.

Principles of Mechanism.—This embraces the general subject of kinematics, and has to do with the laws governing the motion of the parts of a machine, but without reference to the forces producing the motion. It also proportions the moving parts of a machine regardless of strength, so that certain velocity ratios may be insured or certain desired movements accomplished. Text-books and books of reference: Goodeve's Principles of Mechanism; Stahl and Wood's Elements of Mechanism; MacCord's Kinematics; Reulaux's Kinematics. (This class meets three times a week during first term.)

Applied Mechanics.—The application of mechanical laws to structures and machinery. The first term of the year given to this includes the study of prime movers and the general principles of machinery. In connection with prime movers will be given the different ways of transmitting power by belts, ropes, gearing, &c.; and such special machines as hydraulic motors; turbines, their principles, efficiency, &c. Under the general head of principles of machinery will be taken up statistics of structures, including all kinds of frames, trusses, girders, &c. Dynamics of Machines; Dynamics of the steam engine; Friction.

During the second term will be taken up the strength of materials; properties of different metals; strength of elementary structures; iron plates, solid and perforated; riveted and welded joints; strength of all kinds of cast and wrought iron beams, rails, &c. Text-books and books of reference: Cotterill's Applied Mechanics; Rankine's Applied Mechanics; Thurston's Materials of Engineering; Clark's Tables for Mechanical Engineers.

COURSES IN DYNAMICS.

Thermodynamics.—General discussion of the law of flow of elastic fluids, and the heat equations of the action of steam and other vapors against pistons. Steam, gas, hot air, and oil engines viewed both practically and theoretically as heat engines. Lectures on the methods employed in making engine, boiler, and pump tests will be given, and when an opportunity occurs the actual test will be made. The theory and construction of the working parts of engines will be studied and

considerable time devoted to valve gears and link motions. Reference and text-books: Goodeve's Steam Engine; Rose's Modern Steam Engines; Rankine's Steam Engine.

Designing.—The application of the previously studied principles underlying the motion, strength, &c., of the parts of machinery, to some specific machine or mechanical apparatus, and the calculation of its various weights, so that necessary strength may be combined with minimum weight. This will be accomplished both by the aid of text books and lectures. Text-books: Unwin's Elements of Machine Design. (Class meets three times weekly during second term.)

In the last year of his course, the student will submit a thesis on some mechanism planned by him, a test made by him, or a report on some specialty in mechanical engineering; such thesis or test to be full, complete, and accompanied by the necessary drawings.

THE AIM BEING TO GIVE A COMPREHENSIVE VIEW OF THE SUBJECTS TAUGHT.

General Remarks.—The aim in the practical shop-work will be to familiarize the student with the various tools and work-shop appliances, the peculiar uses to which they are adapted, and thus the elements of the trade to which each pertains. The shop experience will be valuable, not so much from the skill acquired, though it is hoped this will not be inconsiderable, as from the fact that it will give a knowledge of the capabilities of the trades the students may expect to employ in carrying out his professional work. Knowing the possibilities of the shops, his designs can be made to conform to the best and cheapest way of executing them. An understanding of heavy, expensive, and special tools will be afforded by photographs, drawings, and descriptions during the regular course in mechanical technology.

Lectures will be given on the erection of machinery, terbines, injectors, indicators, brakes, the standard pumps, and their valve gears, belting, pullies, shafting, &c., together with descriptions of those in common use, and it is hoped in this way the student will acquire an understanding of the principles employed in the construction of such mechanical contrivances and supplies, as well as become familiar with the apparatus he may expect to use in his future work. The above are only a few of the subjects embraced in the lectures, and are mentioned merely to indicate the nature of the subjects to be comprehended by them. Notes will be prepared on the repair, care, and management of machinery, and on the numerous things in regard to the general subject of mechanical engineering that may suggest themselves from time to time, and which should be known, but are not generally embodied in text-books.

Graduate Course in Mechanical Engineering.—Strength of materials: particularly relating to the material used for structural purposes. Contracts and specifications: details and methods of drawing specifications and contracts for engines, boilers, pumps, foundations, power tools, &c.; making estimates as to cost, weight, and space occupied. Hydrodynamics: Theory and efficiency of various types of turbines and water wheels. Laboratory work: Practice in experimental work, such as boiler, engine, and pump tests; measurement of power; tests of the effects of engines under constant and variable loads. Visits of inspection to the various industries of the State, and special reports upon the maintenance, equipment, and condition of the plant.

It will be the aim to supplement the work of the department with a course of lectures by the best Mechanical and Hydraulic Engineers of the State.

This course leads to the degree of Bachelor of Science. To obtain the degree of Master of Science, an additional year of schooling is required "with *proficiency* in a graduate course, in not less than three scientific studies." For the degree of Mechanical Engineer,

a graduate course of one year, "including Designing, Metallurgy, practical testing of engines and machinery for efficiency, and the study of present engineering practices and precedents," is required.

The expenses of students for the college year, are estimated at about $200.

The statistics of the attendance of students in the various colleges and Professional Schools of the University, are condensed as follows:

RECAPITULATION.

	Coll. of L. A. & S.	Coll. of A. & M. A.	Total.	
Graduate Students				8
Under-Graduates:				
Seniors	19	10	29	
Juniors	11	11	22	
Sophomores	11	11	22	
Freshmen	21	9	30	
	62	41		103
Special Students:				
Second Year	0	3	3	
First Year	0	3		
				6
Elective Students	9	19		28
	71	66		
	Coll. of Phar.	Law School.		
Professional Students:				
Second Year	11	9	20	
First Year	6	13	19	
	17	22		39
				184
Names counted twice				2
				182

The "General Faculty and Officers," of the University; comprise Thirty in all. John M. McBryde, PH. D., LL. D., is the President. James Woodrow, PH. D. (Heidelberg), M. D., D. D., LL. D., Dean of "the College of Liberal Arts and Sciences."

The Faculty of "the College of Agriculture and Mechanic Arts" numbers eighteen Professors and Instructors, in addition to the President of the University. Professor Benjamin Sloan (West Point,) is Dean of the College. and Professor of Physics and Civil Engineering.

Claflin College, of the University of South Carolina.

South Carolina Agricultural College and Mechanics Institute, (Claflin University), is situated at Orangeburg, on the line of the South Carolina Railroad, 80 miles from Charleston, and 50 from Columbia, the State Capitol.

As a branch of the State University of South Carolina,* this col-

*The University of South Carolina shall be, and it is hereby, divided into two branches, the one located in the City of Columbia, and styled the South Carolina College, and the other in or near the town of Orangeburg, to be styled the Claflin College; * * *." Sec. I, Act of March 22, 1878.

lege divides the income of the National land grant fund with the South Carolina College of Agriculture and Mechanics, situated at Columbia.

HISTORY.

In July, 1869, the buildings formerly occupied by the Orangeburg Female College were purchased through the efforts of Revs. Dr. A. Webster and T. W. Lewis, aided financially by the distinguished family whose name it bears. In December following a liberal charter was obtained from the State of South Carolina, declaring that no particular religious opinions shall be required as a test of office of any instructor in the University; and that no student shall be refused admission or denied any of the previleges or honors of the said University on account of race, complexion, or religious opinions which he may entertain.

By aot of Legislature, approved March 12, 1872, the Agricultural College and Mechanics Institute was located at Orangeburg, in connection with Claflin University.

AGRICULTURAL COLLEGE AND MECHANICAL INSTITUTE.

In the Act of Congress granting public lands for the endowment and maintenance of such institutions, the object is declared to be, "without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts."

To carry out this design of Congress, an experimental farm was provided, consisting of one hundred and sixteen acres, which, with other lands under the control of the Claflin Board, constitute, in the aggregate, about one hundred and fifty acres of choice land mostly under cultivation. There is also a carpenter shop for practical instruction; and other mechanical departments will, it is expected, be opened as the means shall warrant. Scientific and industrial education are practically united, and the student, by manual labor on the farm and in the shop, can, from his paid industry, aid materially in meeting the expenses of his education.

The classical course of Claflin University, is of four years; and corresponds with that of other American Colleges. The Agricultural and Mechanical course, is of three years. The catalogue affirms that it "is especially adapted to the wants of those who desire a higher education for the industrial pursuits." In the schedule of studies for Sophomore year, "Draughting is included under the general head of Mathematics which embraces also "Conic Sections," "Surveying," "Mensuration" and "Field Work."

"Draughting," also appears as one of the studies in the classical course, in the third term of Sophomore year.

There is a "Normal school course" of three years, and a "college preparatory course" of three years, the first two years of which are the same as the corresponding years of the normal school courses. There is a Grammar school course, of two years.—In none of these courses is there reported any instruction in drawing, other than has been noted above.

In 1881–'82, there were 23 students in the colleges courses; 136 in the Normal and College preparatory; 184 in the Grammar School. Total number of pupils in all courses, 343, of these eight were in the Sophomore class in College; and only twenty were receiving instruction in drawing.—

The catalogue of "the University," and the College, for 1890–'91,* furnishes in itself an interesting "object lesson" of the very practical training in various industries which is here offered to the colored youth of South Carolina. Numerous engravings, showing the students while engaged in the different trades and industries here taught, add to its attractiveness and value. The annual address delivered at the Commencement in 1891, by the Rev. Bishop A. G. Haygood, D. D., so long the managing agent of the "Slater Fund for the promotion of the education of the colored race in America," taken from the report given in the Charleston "News and Courier," is included in the catalogue.

Bishop Haygood, on the Education of the Colored Race.

This farewell address on resigning the management of the "Slater Fund," which he had so efficiently directed for the nine years of its existence, summing up, as it does, the results of his wide experience throughout the whole South; and in which he speaks plainly to all the colored people of the country; can hardly fail to interest all who care for the future of the colored citizens.

As the thoughtful utterance of one who had demonstrated his sincere interest in that race, who has been an active agent in promoting their educational development and who has, at the same time, kept in touch with his fellow southerners of the white race, it is a document well worthy the consideration of all who are interested in the welfare of the whole country. Eight millions of colored citizens cannot be ignored.

The extent of the pecuniary burden undertaken by the whites of the South in the support of their public schools,—providing for the colored children as well as for the white, to which the Bishop called the attention of his colored audience, will give to many in the North a new view of what the people of the South are accomplishing; while his graphic portrayal of the passionate antagonism of the southern whites towards the proposed Federal election law, will doubtless be a surprising revelation.

His showing of the wonderful advance made by the colored race since their first landing as slaves in America, and his wise words of caution and counsel to them in their present conditions, mark this as a memorable address. I have, therefore, in view of all these features of this discussion, thought it well to give it place among the Appendices to this volume.†

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*Catalogue of Claflin University, College of Agriculture and Mechanics' Institute Orangeburg, S. C. 1890–'91. New York Printed by Hunt & Eaton, 150 5th Avenue. 1891. Pp. 88.

†See Appendix Z.

DEPARTMENTS AND COURSES OF STUDY.

The classical and literary features of the education offered at Claflin University remain substantially as given in the preceding account.

The ordinary text books in the Classics, in the Sciences, and in the common English studies, are used. The modern languages are taught through the whole of the scientific course, and through the senior year of the classical course. Drawing is taught in the first year of the three years of the "College preparatory course" and in the first two, of the three years of the "Normal course." Through each of the six "grades" of the "English course," Drawing and Manual Training are taught.

The "Historical Statement" and the details of the courses in the different industries which follow, are taken in full from the pages of the catalogue.

HISTORICAL STATEMENT.

The existence of Claflin University is due largely to the generosity of the Hon. Lee Claflin and family, of Boston, Mass.

The college campus is the original site of the Orangeburg Female Seminary. It contained about three acres of land, pleasantly located and beautifully shaded. There was one large wooden building well adapted for dormitory and class-room purposes, together with a few cheap out-buildings.

In 1869 this property was purchased and set apart to its present purpose.

In December following a liberal charter was obtained from the State of South Carolina.

Later two tracts of land joining the original purchase were secured, containing respectively thirty-seven and thirty acres, making the total number of acres seventy, more or less.

By Act of Legislature, approved March 12, 1872, the College of Agriculture and Mechanics' Institute for Colored Students was located at Orangeburg. An experimental farm, containing about one hundred and sixteen acres, joining the Claflin property, was purchased. For the sake of greater economy and efficiency the two institutions, while distinct in every other particular, are operated practically as one.

In January, 1876, the main building and one recently erected for class purposes were consumed by fire. Soon after a large brick building was erected in the place of the main building which was destroyed, and from time to time buildings have been added until there are over twenty that are used for school purposes.

The farm and campus have been improved, trees planted, walks and drives laid out, fences and buildings put in the best of repair, until the property presents a very attractive appearance. The location is healthful, well supplied with pure water, and is free from malaria.

In addition to the training in Mechanical and Industrial Drawing there is, also, provided for those who wish it, instruction in free hand drawing and painting as follows:

DEPARTMENT OF ART.

Mrs. L. M. Dunton, Instructor.

This department has for its object the cultivation and promotion of the Fine Arts, through practice and criticism. Its aim is to familiarize the student with the theory and practice of art.

It has been found advisable to study elementary or geometrical forms by drawing, advancing to copies in architectural and ornamental designs. As the study of perspective can be acquired as well by the brush as with pencil, therefore the course in art will be selected by the student. The choice will be optional, whether pursued with pencil, crayon, pestelle, India ink and sepia, or with the brush and colors.

Free-hand drawing and painting is made a specialty, since it furnishes the only basis for accuracy in observing nature and art, and secures freedom and precision in delineating and executing designs. Drawing and painting from objects or from nature are most practiced. Composing or designing is only allowed those pupils who have an innate talent for such work. Only one among the many receive this latter gift. But the development in the mind of the pupil for a love and a fair execution of fine art can be accomplished by the prescribed course. Far more attention is paid to painting in oil-colors than in water-colors. During the spring term it is designed to form classes to sketch from nature, as soon as there has been developed in the mind of the pupil a talent for this work. The course of instruction in painting and drawing, covering three years, is arranged as follows:

First Year.—Drawing from objects, mechanical and architectural—linear and perspective. Painting: technical practice; ornamental home decorative painting.

Second Year.—Technical practice; copying from masters; studies in still-life or nature. Lectures accompanying each lesson on harmony and blending of color; chiaro-oscuro and composition.

Third Year.—Perspective painting; technical practice; studies from living models; portrait-making; composition or designs in landscape. Lectures on the Theory and Practice of Art.

Each year lessons will be given in minor painting, covering studies in the imitation of natural wood or painting and graining.

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Department of Manual Training.

The age is becoming more practical. In the past the effort of our schools and colleges has been to cultivate the mind, leaving the training of the body largely to the freaks and circumstances of the student.

The monotony of school life has been broken by the introduction of athletics, which under proper restrictions can not be commended too highly. But nothing has been hailed with so much satisfaction, both by students and patrons, as the introduction of manual training.

The advantages arising from the systematic training of the body and the hand and the teaching of trades and industries in connection with courses of literary culture are so patent that no excuse or argument is needed to convince the thoughtful mind of the wisdom of the undertaking.

Over $20,000 have been spent in supplying outfits for the various industrial departments of Claflin University, and it is the purpose of the management to make it a first-class manual-training school.

The object of the industrial feature is to give instruction in manual training and to teach trades in connection with literary studies.

In order to provide for manual training there is no effort to lower the literary standard of the University, to consume time that properly belongs to that department, or to detract in any way from the broadest and most thorough literary culture.

The question really at issue between the old and new schools is not in regard to the necessity for recreation, nor the amount of it a student needs, but whether he shall obtain it in the gymnasium, on the diamond, at the regatta, or in the shops.

There are arguments that seem well to sustain both theories; but to the student

of moderate means, who is dependent upon his own energies and resources for a livelihood, there seems to be but one choice.

The best education, for the masses at least, is that which develops most completely all that there is in a man, and that places the entire resources of his nature most thoroughly at the command of their possessor.

That literary training is of paramount importance few will deny; but the training of the mind, the body, and the soul simultaneously seems to be more in accordance with human needs. The mind may be trained to think, but unless the eye is trained to see, the ear to hear, and the hand to execute, much power will necessarily be lost.

To many the education of the past has been too theoretical and visionary, and has educated men out of their spheres rather than into them, while the new education seeks to be broader, more practical, and more useful.

The shops themselves are an object lesson; for in them the student is brought into contact with a great variety of material, tools, and machinery. His vocabulary touching these things is increased, and he is much better prepared to deal with mechanics and appreciate the value and utility of their productions.

Experience has demonstrated that the subjects taught in the literary departments receive a new inspiration from the practical applications which are made of them in the manual-training departments. For instance, there is scarcely a principle of mathematics that is not found useful and helpful in the mechanical departments. Students soon learn that mathematics is as essential to them as the tools in their hands, and, consequently, a subject that has seemed abstract and uninteresting suddenly becomes one of the most interesting in the curriculum.

Claflin University has in successful operation the following trades and industries:

A list of twenty different "schools," with the number of pupils attending each, follows: as these figures are repeated in the very full "summary" of students, which will be given later, they are here omitted.

It will readily be seen from the details given of instruction in these various occupations, that much of it is of that same practical kind of training as is given in a "Trade School"; and it seems for this very reason, wisely adapted to the needs of the pupils; being such as is calculated to fit them to become self supporting members of society.

ARCHITECTURAL AND MECHANICAL DRAWING.

"Drawing," says one, "is the very soul of true technical education, and of exact and intelligent workmanship." Drawing cultivates perception and stimulates invention. It often enables to express by diagrams what can not be so readily and clearly expressed by language. It is regarded of first importance in all manual-training schools. Students are first taught to work out their lessons on paper, and when the object that they desire to make is clearly defined in their minds, then the tools and material are placed at their command for an actual verification of the principles they have learned.

COURSE OF STUDY.

Selection and uses of drawing instruments.
The use of the scale as applied to drawing.
Simple geometric constructions involving the use of instruments, definitions, etc.
Lectures on the history and development of architecture.
Free-hand drawing of scrolls, irregular objects, etc.
Drawing from models to a scale.
Sections and intersecting drawings.

Drawing plans for wood, brick, or stone constructions and foundations.
Drawing elevations in wood, brick, and stone interiors and exteriors.
Principles of designing.
Original designing—plans, elevations, etc.
Detailed or working drawings.
Exercises in writing specifications, contracts, etc.
Lectures on building and superintendence.
Lectures on historic styles of architecture and ornamentation.
Lectures on ventilation.

SCHOOL OF CARPENTRY.

This department is furnished with benches, tools, etc., for classes of twenty.

Lessons are given from drawings prepared by the superintendent.

Students are taught the names and uses of tools, and how to keep them in order.

A variety of actual work is performed, such as building cottages, shops, repairing buildings, making and repairing furniture, ornamenting buildings and campus, building and repairing fences, making and repairing agricultural implements, making wardrobes, etc.

The following is the course of study to be pursued:

I. Exercises in methods of holding and using try-square, gauge, dividers, bevel, saw, mallet, chisel, and plane.

II. Elementary framework—cross lap joint, tenon and mortise joint, end T. & M. frame, and blind T. & M. brace frame.

III. Lathe work—cylinders, spindles, handles, rosettes, etc.

IV. Advanced framework—miter lap joint, dovetail joint, lap dovetail joint, methods of scarfing, keyed joints, double dovetail puzzle, etc.

V. Small articles, embracing framework, nail-driving, turning, scroll-sawing, and miscellaneous work.

VI. Cabinet work—sawing, turning, framing, wood-carving, paneling, brackets, plain bedsteads, washstands, tables, etc.

WOODWORKING BY MACHINERY.

This department is supplied with a 40-horse power boiler and engine, planer, rip saw, jig saw, cut-off saw, variety machine, three turning lathes, boring and mortising machine, etc. Students are taught how to operate the machines and how to keep them in order. By the combined efforts of the departments of carpentry and machinery the University has been enabled to do its own building, repairing, and to manufacture its own furniture.

SCHOOL OF BLACKSMITHING.

This department is fitted up with eight forges, driven by a steam fan, and with the necessary outfit of tools, vises, drills, etc. The course of instruction includes the care and management of the fire, and lessons in heating, holding, and striking iron. Drawing, upsetting, shaping, bending, punching, cutting, breaking, welding, hardening and tempering steel.

Considerable attention is given to repairing. Many shop tools have been made, such as tongs, hammers, swedges, fullers, punches, chisels, flatters, cleavers, hardies, headers, bending-forks, tire sets, drawjacks, traverse wheels, wrenches, bevel-squares, try-squares, screwdrivers, pincers, clinch knives, toe knives, shoe hammers, masons' hammers, calipers, etc. Special attention given to filing and finishing, and there are many specimens of work on exhibition that do credit to the department.

SCHOOL OF MILLING.

A first-class mill has been furnished, and students are taught how to grind corn into meal, grits, and hominy. Feed is also ground for the stock.

BRICKLAYING.

Students are first taught the names and uses of the tools. Then follow lessons in the kinds of materials and their uses, mixing mortar, cement, etc.

Practice is then given in laying walls, corners, window and door caps, arches, flues, chimneys, cornices, etc.

During the early part of the course good work only is sought, but later good work and speed are insisted upon.

Instruction is also given in reading plans and specifications. Students who wish to stand at the head of their business will join a class in architectural drawing.

Two large boilers were set, several foundations for buildings put down, forges and flues built, and a great variety of practice-work accomplished last year.

PLASTERING.

Special instruction is given in lathing, plastering, whitewashing, and frescoing. Samples of this work are upon exhibition at the University.

One house was plastered, repairs made, and practice-work done last year.

This department is attractive, and many students have learned enough in one year to command good wages during their vacation.

STEAM LAUNDRY.

A commodious two-story building has been erected and furnished with the most improved laundry machinery, the entire outfit costing $4,000. The object of this enterprise is to give instruction in all that pertains to good laundering, so that young ladies may have the advantage of their training in their homes or may follow it as a business.

The work of the University is done here, and girls of moderate means may earn a part of their necessary expenses by doing extra work.

SCHOOL OF TAILORING.

This department started under favorable auspices, but owing to the expense of material and our inability to compete with ready-made clothiers we have decided to confine the work of this department entirely to repairing, cleaning, and dyeing.

SCHOOL OF PRINTING.

This department is under the management of an experienced printer. The office is furnished with a good press and sufficient material to do a nice line of jobbing and to publish a small paper called the Claflin Miscellany. The printing class was large last year, and commendable progress was made by the apprentices.

SCHOOL OF HOUSE-PAINTING.

Lessons are given in colors and in mixing and applying paints and varnishes, also in graining and frescoing. Last year the classes painted the exteriors of six buildings, besides considerable practice-work. Specimens of the work of this department are on exhibition at the University.

COOKING.

Classes are taught both at the Simpson Industrial Home and at the University. The departments are furnished with the necessary outfit of appliances and material.

These classes have usually furnished the whole or a part of a dinner once a week for all of the students in the boarding-hall.

Special attention has been given to the cooking and serving of plain foods in different ways.

Through the liberality of a gentleman in the West the erection of a building especially for this department is made possible.

The following course of instruction will be pursued: Care of ranges. Cooking cereals. Soups. Regulating fires. Cooking meats. Making bread. Making desserts.

COOKING FOR THE SICK.

Meat soups and broths. Cooling beverages. Cereal soups and broths. Dainty dishes and relishes.

NURSE TRAINING.

This department undertakes to give such instruction as shall enable students to take intelligent care of themselves and the sick.

NURSE-TRAINING COURSES—NON-PROFESSIONAL.

First Year.—Study as to Care of the Sick Room—Ventilation, Temperature, Furnishings, Disinfectants in Infectious and Contagious Diseases. Philosophy of Hot and Cold Water Baths, and how to administer them in all diseases.

Study of Applications—Cupping, Enemata, Suppositories, Poultices, Counter-irritants, Lotions to Relieve Pain. (Massage and Swedish Movements.)

Instruction in Fever Nursing—Typhoid, Malarial, Scarlet, etc.; Small-pox, Measles, Mumps, Diphtheria.

Second Year.—Method of Ascertaining and Noting Pulse, Temperature, and Respiration. Administration of Anæsthetics. Surgical Nursing. Application of Bandages and Splints.

Preparation and Method of Serving Food. Preventing and Dressing of Bed-sores, and Arranging Positions. Method of stopping Hemorrhage. What to do in Emergencies—Drowning, Sun-stroke, Struck by Lightning, Burns, Bites, Bleedings.

PROFESSIONAL.

Third Year.—To complete a course preparatory to Professional Nursing, the following additional year of study is required.

Special Anatomy and a Thorough Course in Midwifery, Chemistry, Materia Medica, Therapeutics, Toxicology, Theory of Poisons.

PLAIN SEWING.

All of the girls not members of the dressmaking classes are required to take plain sewing. So far as we are able we provide them with material for the making of useful articles; but many are kept upon sample or practice work. We find no difficulty in keeping up an interest, and even an enthusiasm, in this department.

By our new system of dress-cutting by measure any girl of ordinary intelligence can learn in one year to cut and make a dress in good style. Persons who are not members of the University are at liberty to learn the system by the payment of a small fee.

SIMPSON INDUSTRIAL HOME.

Another important Industrial feature is the Simpson Memorial Home, established by the ladies of Philadelphia, in memory of the late Bishop Matthew Simpson, one of the bishops of the Methodist Episcopal Church. A neat two-and-a-half story building, containing twelve rooms, has been erected and furnished throughout.

The Home is under the care of a matron, who gives daily instruction in the art of Domestic Economy. Several girls reside permanently in the Home, and have the constant benefits of the same; others are sent by classes from the University for instruction in cutting, sewing, and ornamental work.

This school is under the auspices of the Woman's Home Missionary Society of the Methodist Episcopal Church.

COURSE OF STUDY IN THE SIMPSON INDUSTRIAL HOME.

First Term.—Plain Cooking, Plain Needlework, Laundry Work, General Housekeeping, Good Manners.

Second Term.—Bread-making, Cutting and Sewing, Laundry Work, Care of Sick, Hygiene, Lectures.

Third Term.—Pastry Cooking, Dressmaking, Fine Laundering, Millinery, Hygiene and Sanitary Regulations.

Care of Rooms, General Housework, and Work in the Dining Halls required every day.

DEPARTMENT OF AGRICULTURE.

The School of Agriculture was established in 1872, and is sustained by a portion of the interest accruing from the Agricultural Land Scrip of South Carolina. This department provides a farm of about one hundred and sixteen acres, a superintendent, and a sum of money to meet incidental expenses and to pay students for necessary labor. The funds at command are not sufficient to warrant much outlay in experimental farming. The special effort of the department, therefore, is to give the students lessons in practical farming. There are about one hundred and twenty acres of land under cultivation, and the following figures will indicate the products of last year: 1,600 bushels of Corn. 2,200 bushels of Sweet Potatoes. 300 bushels of Oats. 50 bushels of Clay Peas. 26 bales of Cotton. 2,500 quarts of Milk. Meat and Vegetables.

The farm not only furnishes valuable employment to students, but supplies largely the demands of the University Boarding Hall.

The Boarding Department pays the market price for all provisions obtained from the farm.

Claflin University is fully committed to Industrial Education. The time has now come when most boys and girls must get their preparation for their life-work in the schools. Experience has shown that in connection with a course of mental training a student has time to acquire a trade, and that a few hours per week devoted to industry cultivates not only the hand, but the head and heart as well.

The expenses of the students are very light; for "lodging, board, tuition, washing, etc.," the "Boarding pupils" pay $8.50 per month. Day students pay from one to two dollars per month, as they are less or more advanced.

It hardly needs to be said that this would not be possible unless three fourths of the expenses of the institution were otherwise "provided by the voluntary contributions of the friends of education; through the Freedmans Aid, and Southern Education Society, by the State of South Carolina, and by the Slater and Peabody Funds."

The following statement gives in detail, the number of pupils in attendance in the different departments and those learning the several "trades and occupations."

SUMMARY.

	Males.	Females.	Total.	
College—				
Seniors	0	0	0	
Juniors	3	0	3	
Sophomores	3	0	3	
Freshman	5	2	7	
				13
College preparatory—				
Third year	17	2	19	
Normal—				
Third year	9	12	21	
Second year	31	11	42	
First year	36	13	39	
				112
English School—				
Sixth grade	49	24	73	
Fifth grade	43	36	79	
Fourth grade	71	58	129	
Third grade	64	35	99	
Second grade	60	33	93	
First grade	52	40	92	
				565
Night school	220	86	306	
Teachers' class	9	16	25	
Instrumental music	4	17	21	
Theological class	32	0	32	
Agriculture	40	0	40	
Architectural drawing	13	0	13	
Art decorations	0	20	20	
Blacksmithing	98	0	98	
Bookkeeping	17	0	17	
Bricklaying	92	0	92	
Cabinet-making	20	0	20	

	Males.	Females.	Total.	
Carpentry	165	0	165	
Cooking	0	35	35	
Crocheting	0	120	120	
Domestic economy	0	13	13	
Dressmaking	0	36	36	
Engineering (steam)	15	0	15	
Gardening	12	0	12	
Glazing	6	0	6	
Grinding (cereals)	8	0	8	
Laundering (steam)	10	60	70	
Nurse training	14	1	15	
Painting and graining	92	0	92	
Penmanship	339	226	565	
Plaining and sawing (steam)	20	0	20	
Printing	69	10	79	
Sewing	10	180	190	
Shoemaking	21	0	21	
Boarders	238	112	350	
Graduates 1891:				
College preparatory	4	2	6	
Normal	1	4	5	
Total graduates:				
College	22	5	27	
College preparatory	15	2	17	
Normal	67	79	146	
				201
Total attendance, 1891	443	266	709	
Sterling department*			255	
Grand total for 1890 and 1891			964	

* We do not expect to report the Sterling Department after this year.

The "University," and the "College, have different corporations, though they are practically operated as one institution. The Governor, the Chief Justice, and two associate Justices of the Supreme Court, The State Superintendent of Education, and the Chairman of both the Senate and the House Committees on Education, are "Ex officio," members of the Board of Trustees of "The Claflin College of Agriculture and Mechanics Institute." There are also nine "elective members." The College Faculty, numbers six Professors in addition to the President. The Preparatory and Normal Faculty is composed of the same Professors; with the addition of one "Adjunct Professor" and one "Instructor."

There are eight teachers in the English Schools. There are a number of assistants in the Trade Schools.

Rev. L. M. Dunton, A. M., D. D., is President.

CHAPTER XIV.

UNITED STATES LAND GRANT COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS—Continued.

ANALYSIS OF CHAPTER.

THE UNIVERSITY OF TENNESSEE AND STATE AGRICULTURAL COLLEGE, KNOXVILLE, TENNESSEE.

The Act of Congress of April 1806, gave to the State of Tennessee one hundred thousand acres of land for school purposes. Two colleges were to be established by act of State Legislature. In accord-

ance with the provisions of the law of Congress, the necessary acts were passed by the State Legislature October 26th, and December 3d, 1807, and the Trustees of East Tennessee College were incorporated to have charge of one of these colleges. Soon after, the franchise and property of Blount College, chartered by the Territorial Legislature in 1794, were transferred to it. This college continued under this charter more than sixty years. In 1840, it was made a University; and the Trustees, were made "The Trustees of the East Tennessee University."

By act of January 16, 1869, the Legislature gave in trust to the University the proceeds of the United States land grant under the law of 1862, for the purpose of establishing "The Tennessee Agricultural College" as a part of the University.—The trust was accepted and the college organized the same year. Three courses of study, The Agricultural, The Mechanical, and The Classical, were provided. These were arranged in three separate colleges in 1877, acting under the one University head. In 1879, at the request of the "Trustees," the Legislature changed the name to that of "The University of Tennessee."

The College held a tract of forty acres of land contiguous to the City of Knoxville, on which were the several buildings of the institution.

When the Agricultural College was established a desirable tract of 285 acres, a half mile distant, was purchased for use as the farm. The law requires a biennial report to be made by the Trustees to the Legislature. The first one, made October 1869, gives details of the possessions of the University and of the purchase of the agricultural farm, etc., and, also, gives an account of the visit of the Trustees to such other State Agricultural Colleges, as had then been established; and makes a strong argument for the promotion of scientific studies instead of making a mere manual labor school for farmer boys. Two preparatory schools, one for admission to the scientific and one to the classical course, were provided by the trustees. The college opened September, 1869, with 104 students; of whom 27 were in regular college classes.

Some changes were made in reorganizing under the name of the State University.—The elective system was adopted, each professional branch was called "a school", and these were grouped into colleges; as The "College of Agriculture", The "College of Engineering and Mechanic Arts", and the "Classical College."

The following statement in regard to scientific education is taken from the Catalogue of 1878–79.

Of the Scientific Colleges, their origin and objects, a few words here may not be out of place. There are many who, feeling the need of a course of instruction which shall in some points differ from that of the Classical College, have misconceived the scope of the College best fitted to supply the need, and many others utterly opposed to the Science College, under the erroneous conviction that it is to be built up at the expense of, or in antagonism to, the old College.

Origin of the Science College.

The main feature of modern progress, next to the elevation of the masses, is the application of machinery to the industrial pursuits of life. In former times, men studied the forces of nature as means of recreation, but now they seek rather to conquer and domesticate them, and have attained such success in this that it is no exaggeration to say that the entire frame-work and running gear of modern life is based on and controlled by Science. Every improvement of the present age is, indeed, due to some scientific discovery. This condition of things, and the persuasion that the perpetuity of these improvements depends on the continuance of that scientific knowledge to which they owe their origin, has created an imperative demand for school and college instruction in those principles, or for what is known as practical education. Formerly it was thought that a College Education was needed only by physicians, lawyers, clergymen and gentlemen of "elegant leisure." All other occupations were mere handicrafts, or trades, to be practiced by the rule of thumb. But now something more than skill is demanded of the master workman. He must have knowledge, and this knowledge he must seek in the schools.

The Science College is a response to these demands. It is a later and riper fruit of the same general movement, that gave rise to the common schools for the people. In some measure it is but a further development of the same growth; different only, in that it answers to a higher and more special want.

Objects of the Science College.

The Science College has for its primary objects to teach the principles of the physical and natural sciences, which relate to, and underlie all of the industrial occupations, and to train its pupils to such mental habits as will most thoroughly fit them for their special work in life. But the Science College holds that to develop the mental and moral faculties of its students, is of right the primary and dominant purpose of every college, be it classical or scientific. Culture is its end and aim. No college can wisely take for its highest, or recognize as its ultimate aim, the preparation of its students for being mere bread-winners; to qualify them merely for making a living.

There is a need for emphasizing this higher view of education, and especially of the education of the industrial classes. With the majority of parents who send their sons to College, the commercial value of the education they are to get is the controlling value. And there are well meaning, but unwise persons, who would limit the work of the Science College to mere handicrafts of the industrial arts. Such a course might turn out fair farm hands from the College of Agriculture, or good journeymen mechanics from the College of Engineering and Mechanic Arts but it would be an exaggeration to speak of them as educated men; and a misnomer to call such institutions colleges. Farm hands and journeymen mechanics can be more quickly, more thoroughly and more cheaply made on any well managed farm, or in any well conducted workshop, than in a college. One of the highest practical aims of the Science College is to elevate the standard of life among the industrial classes, and to lower its work to this level, is to rob it of half its value, and that the higher and better half. The very general shrinkage in values of property, and the common necessity of working for a living, lends color to this low view of the aims of education; even with some, who really and rightly value the higher education. It is not that they appreciate culture less; not that they admire scholarship less, but that they feel more the need of a working education. Time, however, will remedy this. Day by day, and year by year, science will be esteemed and pursued more for itself alone; and the estimates of the relative commercial and culture values of a scientific education will change.

The Biennial Report to the Legislature, made January, 1881, thus details the changes in the course of study.

COURSE OF STUDY.

Since our last biennial report the course of study in the University has been materially modified and greatly enlarged. Its flexibility has also been increased by introducing to a larger extent than heretofore the elective principle, under which students, with the advice of parents, and with the approval of the faculty, are allowed to select their own course of study. * * * *

At the same time the regular course of study in the several departments of the University have been both increased and more carefully adjusted. The classes in each department have been correlated according to a fixed schedule of hours, which admits of largely increased time for instruction, and are thus arranged into several continuous and complete courses of study, open to the option of the student, and each leading to its appropriate degree.

Thus have been arranged the following courses, each of four years:

1. A General Science Course—Degree Bachelor of Science.
2. A General Classical and Scientific Course—Degree Bachelor of Arts.

And the following special or technical courses:

3. A Course of Civil Engineering—Degree Bachelor Civil Engineering.
4. A Course of Mechanical Engineering—Degree Bachelor Mechanical Engineering.
5. A Course of Mining Engineering—Bachelor Mining Engineering.
6. A Course of Agriculture—Degree Bachelor of Agriculture.
7. A Course of Applied Chemistry—Bachelor Applied Chemistry.

In addition to these regular and complete courses of four years there have been also arranged the following partial courses, each of two years, designed for students whose time or means may not allow a full course, viz:

8. A Course of Practical Agriculture.
9. A Surveyor's Course in Applied Mathematics.

The catalogues for the past few years show that drawing, both free hand and mechanical, has been held as essential; both in the Agricultural, Scientific and Engineering courses. "Fifty lessons in free hand drawing are also given during the year (in addition to the thorough training in geometry before mentioned,) to all scientific Freshmen."—A similar account of additional "drawing" is given in Sophomore year. In the notice of the studies of the school of Applied Mathematics, in the Biennial Report for 1881, occurs the following:

Descriptive Geometry is the foundation of both the science and art of drawing. It is followed by a course of problems in shades, shadows and perspective—mechanical drawing.

The course of engineering consists of the subjects treated in Prof. Gillespie's Roads and Railroads and Prof. Wood's revision of Mahan's Civil Engineering and of a course of lectures by the instructor on surface and thorough drainage, on agricultural, hydraulic and marine engineering, and a brief outline of the science and art of military engineering. The engineering drawing consists of a course of instruction in the drawing of plans, sections, elevations and details of bridges, tunnels, canal locks, etc.

For the above engineering course students can substitute mechanism, machinery and machine drawing.

The value of drawing in its relations to scientific training is evidently highly appreciated and due provision is made for it in the courses in Agriculture, Engineering, and applied Mathematics.

In 1879'–80, there were 157 pupils in the collegiate department. In preparatory schools 132, and in the Medical Department 126, giving a total of 401.

In the series of "Contributions to American Educational History" issued from time to time, as "circulars" by the U. S. Bureau of Education, the circular "No 16," issued in 1893,* contains a very interesting resumé of the history of the University of Tennessee,—from its beginning as Blount College 1794, down to 1892—prepared by Professor T. C. Karns, M. A., Associate Professor of History and Philosophy in the University. (See pages 63–106 of this circular.) This account is illustrated with views of the buildings and, also, of the interiors of Laboratories, Reading Rooms and Workshops; showing the additions that have been made in recent years to the equipment of this institution in providing ample facilities for thorough education in Science and Mechanics.

LATER HISTORY.

The Board of Trustees of the University are required by law to make reports biennially to the State Superintendent of Public Instruction. From the latest report, that for the two years ending December 20th, 1892, the following statements of the recent additions to the buildings and equipment, as well as of the increase in attendance during recent years, are taken.†

* * * * * * *

We are glad to be able to report again that the University has continued to prosper, and has extended its influence in many new directions.

Among material improvements, we can mention the completion of the Science Hall, commenced in 1890; the erection of a building for a gymnasium and the use of the Young Men's Christian Association of the University; the complete remodeling and refurnishing of academic building known as South College, and the erection of two additional houses for professors.

The opening of Science Hall was celebrated in due manner at commencement, in June, 1892, and it was regularly occupied by the several schools at the opening of the present session.

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*Bureau of Education Circular of Information No. 5. 1893. Whole number 196. Contributions to American Educational History, edited by Herbert B. Adams. No 16, Higher Education in Tennessee by Lucius Salisbury Merrian, Ph. D. Sometime Fellow in Political Economy in Johns Hopkins University; Instructor in Political Economy in Cornell University. Washington, Government Printing Office, 1893. Pp. 287, Ill.

†Report of the Board of Trustees of the University of Tennessee to the Superintendent of Public Instruction. Two years ending December 20, 1892. Nashville, Tenn. Marshall & Bruce, printers to the State, 1893. Pp. 75.

DESCRIPTION OF SCIENCE HALL.

The Science Hall is an imposing structure of brick and stone, four stories in height, with a slate roof, having an area of about 30,000 square feet of floor space, besides a large basement. It is a simple development of Romanesque architecture. Its chief feature is a beautiful tower, rising one hundred and fifty feet from foundation to finial, with an open observatory. The south wing contains the auditorium and physical laboratory; the large north wing, the chemical laboratories, library, engineering rooms, and the offices of the President.

Fronting the entrance is the handsome reception-room, and to the right is the auditorium. The latter, a spacious room, has an inclined floor, set with opera chairs, and a large gallery, set with benches. It has a seating capacity of seven hundred. Especial attention has been paid to the lighting and ventilation here. The platform is provided with all the conveniences for scientific and other lectures, and there is a large projecting lantern for purposes of illustration. A grand pipe organ stands in the gallery.

The distinctive feature of the building is its system of heating and ventilating. The "direct-indirect" system is used, in which the radiators are so constructed that fresh, warm air is brought into the building. The foul air is taken out at the floor and ceiling by twenty-one stacks, ten of which, eighty-five feet high, are in the centre of the building. The building is lighted with incandescent electric lights.

On the first floor, south end, are the laboratories of the School of Physics, paved with asphalt, resting upon the ground, in order to give a firm foundation for instruments of precision. They are spendidly lighted through numerous large windows. Two Edison dynamos (one hundred and twenty-five volts) furnish the electric current. The gas, water, steam, and drain-pipes are in trenches, covered with marble slabs. The lecture-room has raised seats; a conveniently arranged lecture-table, provided with gas, water, and electric current; windows arranged to be darkened at pleasure for lantern illustrations, etc.

The assay laboratory is also on the first floor, and is equipped with a Blake ore-crusher, a heavy pulverizing plate, a new gold and silver smelting furnace, a gold and silver cupelling and refining furnace, and many other interesting appliances.

The chemical laboratories are located on the second or main floor, north wing. They are supplied with an abundance of light from large windows, and ventilated by ten stacks, and elegantly furnished with well-contrived desks, hoods, sinks, etc.

On the second floor from the entrance are the President's handsomely furnished office and reception-room. The remainder of this floor is devoted to the library.

The fourth floor (third from entrance) is occupied by the School of Civil Engineering. It contains a large draughting-hall, magnificently lighted and supplied with adjustable draughting-stands, etc.; dark-room for making blue prints and photographs; laboratory with water-tanks, weighing-scales, and testing-machine, with micrometer and other appliances; laboratory and museum for specimens, engineering materials and devices; an engineering instrument-room, with lockers for the individual instruments; professor's office, and store-room for maps, drawings, etc.

BUILDING OF THE Y. M. C. A.

The building erected by the Young Men's Christian Association of the University has also been completed and occupied since our last report. It is a substantial structure of pressed brick and stone, covered with slate, and was planned with special reference to its uses. It is considered by those who have seen many such buildings to be the model of its kind. The building contains, in addition to the usual offices, a parlor, a reading-room, an assembly room, and a large gymnasium fitted with the best apparatus, in connection with which are baths, lockers, etc., which is open

to all the students of the University. An instructor is provided by the Association to direct the young men in physical culture.

The finances of the institution continue in a healthy condition. The Board has received all funds due it, and has disbursed them in accordance with the laws of the State and the statutes of the United States. The biennial report of the Treasurer, which is submitted herewith, will show the details of the receipts and disbursements.

The attendance upon the Academic Department of the University has been as follows during the last six years:

	From Tennessee.	Total.
1886–87	148	160
1887–88	190	203
1888–89	231	249
1889–90	233	259
1890–91	208	229
1891–92	210	241

The attendance this year to date upon this department is two hundred and thirty-eight. This would indicate a still larger attendance for the session of 1892–93, as many students enter the second term, especially those taking the teachers' course.

This report, which urges the need of new and better buildings, and which gives in detail many facts which bear upon the relation of the State officials to the University, is signed by Charles W. Dobney, Jr., President of the University, and J. W. Gaut, Secretary of the Board of Trustees.

Reports by the President and the Professors in charge of the Departments of the University, accompany that of the Trustees.

Perhaps the growth of the University during recent years in both material equipment and in its educational work, cannot be better shown than is done in the following tables; in which the President in his own report, has summarized the statistics, which set forth the increase in buildings and equipment and give, in detail, the attendance on the several courses of study. The extracts which follow, comprise but a small part of the President's report; which is largely given to details showing the general condition of the Institution. It begins as follows:

Report of the President.

To the Honorable the Board of Trustees of the University of Tennessee:

Gentlemen: In submitting this, my third biennial report as President of the University of Tennessee, I am glad to be able to state that the last two years have witnessed continued growth and prosperity in nearly all the departments of the institution. Great improvements have been made in buildings and equipment. The striking fact of this period was the erection of the Science Hall. Material improvement has, in fact, characterized the last five years of the history of the institution. A list of the chief additions to the permanent equipment of the University made during this time will be interesting.

INCREASE OF BUILDINGS AND EQUIPMENT SINCE 1887.

The value in many cases is only approximate. Many improvements had to be made and paid for little by little, and I have only undertaken to collect the largest items from accounts extending over so long a period. Much in the way of appa-

ratus and equipment has been added that is not listed here. Fully two-thirds of these improvements were made during the last two years:

Addition to Agricultural Building and equipment	$12,500
Mechanical Department and equipment	15,400
Electric light plant	3,400
Improvements in Steward's Hall and equipment	2,250
Refitting and refurnishing South College	3,350
Improvements in other old buildings, not including ordinary repairs	2,720
Science Hall, furniture, and equipment	56,000
Gymnasium and equipment (Y. M. C. A.)	6,132
Dairy at farm	550
Additions to equipment of Chemical School	1,250
Equipment of Civil Engineering School	1,100
Equipment of Military Department	552
Equipment of Zoölogical Department	1,035
Physical and Electrical Engineering School	1,700
Offices, furniture, etc	825
Library—3,000 volumes added	6,050
General furniture improved	3,200
College farm, stock, and implements, added hy University	2,800
Industrial Department equipment	2,800
Part on two professors' houses	1,750
Tool-house and stable	375
Approximate value of additions, buildings, and equipment since 1887	$125,739
Experiment Station movable property, apparatus, furniture, etc	9,260

The following other improvements have been made upon the University grounds at expense of others:

President's house	$5,600	
Two professors' houses, exclusive of University payment	8,750	
		$14,350

Grand total of permanent improvements in five years—1887–93.... $149,349

When we consider that the University has received no State appropriation during this time, we believe this will be taken as a very satisfactory exhibition. The buildings were erected and repairs made with the funds accruing from the sale of land, rents, etc. The large additions to equipment for teaching, apparatus, etc., were made out of current funds. These totals illustrate most forcibly the power of littles when saved and invested.

The attendance upon the Academic Department of the University during the session of 1891–92 was as follows:

SUMMARY BY COURSES PURSUED.

I.—*Collegiate course.*

	Sub-Fresh.	Fresh.	Totals.
Latin-Scientific	12	26	38
Agricultural and Scientific		41	41

	Soph.	Jun.	Sen.	Totals.
Latin-Scientific	14	15	7	36
Literary-Scientific	15	4	3	22
Civil Engineering	11	5	4	20
Mechanical Engineering	7	1	1	9
Mining Engineering	..	3	..	3
State appointees at Knoxville College	.	.	..	27
Total Latin-Scientific				74
Total Agricultural and Scientific				41

II.—*University courses (special and graduate).*

Teachers' Course	23
Mechanical Engineering	1
Latin-Scientific	2
Agricultural	1
Chemistry	1
Literary-Scientific	1
Civil Engineering	2
Languages and Literature	3
Mathematics	1
Greek (post-graduate)	1
Total number in Academic Department	234

* * * * * * *

The following shows that in this, as in all live educational institutions undertaking the new methods of scientific and industrial training, the demands for increasing facilities are incessant.

NEEDS OF ADDITIONAL EQUIPMENT.

The various scientific departments need additions to their equipment. The new School of Physics and Electrical Engineering requires many pieces of apparatus, some of which we hope may be secured early in the new year; the School of Civil Engineering needs more and better instruments, a new and more powerful testing-machine, show-cases for specimens, and many laboratory instruments; the School of Zoology and Geology needs show-cases to contain valuable specimens now packed away, additional microscopes, and other apparatus; the School of Agriculture needs most imperatively a new barn and other farm buildings, better agricultural implements, and more stock; the School of Mechanic Arts should have an addition to its building for a foundry, two new lathes, more testing apparatus, and many new pieces of machinery for its shops; the School of Chemistry has only partially equipped its large new laboratories.

Considerable additional apparatus will be absolutely necessary in order to carry out the courses of study already planned. It is plain, therefore, that the board must expect to invest a large amount of money in scientific apparatus for several years to come. We have undertaken to provide facilities for laboratory work in these different sciences and branches of engineering, and as the classes advance the apparatus must be provided. When all of these new schools have been runnine for three or four years, they will have fixed their courses and secured a fairly complete outfit. I advise, therefore, most decidedly, that we do not undertake the establishment of any new scientific schools for at least three years, but devote all the means at our command to the perfect equipment of those already started.

COLORED STUDENTS OF THE UNIVERSITY ATTEND KNOXVILLE COLLEGE.

The opportunities provided for a university training for colored students are thus set forth:

Since our last biennial report, the Industrial Department of the University of Tennessee for the instruction of colored students appointed to free scholarships under the agricultural and mechanical college act, has been placed upon an excellent basis. This department is at Knoxville, Tenn., located about a mile from the University, in immediate connection with Knoxville College, an excellent institution for the education of colored people.

The statutes of the State of Tennessee (see the Code, Article IV., "The Agricultural College," Section 339) direct "that no citizen of this State, otherwise qualified, shall be excluded from the privileges of the University by reason of his race or

color, but the accommodation of persons of color shall be separate from the white." The Board of Trustees of the University have for many years met the requirements of this clause by providing similar instruction, modified to suit the requirements of the students of this race, in a separate department.

ADDITIONS TO THE EQUIPMENT OF KNOXVILLE COLLEGE.

In order to make better provision for the instruction of these students in the sciences pertaining to agriculture and the mechanic arts, a special scientific and shop building was erected last year, and it is now fairly well furnished. It contains shops for work in wood and iron, drawing-rooms, and laboratories for work in chemistry and agriculture. It has a boiler and engine, and the necessary machinery and tools. The laboratories have a good outfit of apparatus. A tract of land immediately adjacent to the building is provided for work in agriculture and horticulture. Two additional instructors have been employed for this department. One instructor teaches the classes in physics, drawing, and mechanic arts, and the other has charge of the classes in chemistry, botany, and agriculture.

A contract has been made with the trustees of Knoxville College under which the State students get their general literary instruction in that institution, but this Industrial Department and its whole course of study are under the supervision and direction of the Board of Trustees of the University, who elect all of its teachers and pay all of its expenses.

COLORED STATE APPOINTEES.

Twenty-seven State appointees were in attendance upon the department last session, but a large proportion of the other students of Knoxville College get considerable benefit from it. Free scholarships in this department are obtained upon exactly the same conditions as in the other department of the Agricultural and Mechanical College.

In order to further encourage this class of persons in securing an industrial education, our Board has established a number of apprenticeships in this department, which enable worthy men to earn from thirty to fifty dollars per annum while in attendance there. They are given work in the shops and on the farm of the department, the service rendered being paid for at its market value. We believe that the facilities for the education of the colored men have been, thus, made fully equal to their present requirements.

NORMAL TRAINING IN THE UNIVERSITY.

The Teachers' Department has made substantial progress during the year. What has been accomplished shows that the department was needed, and is designed to do a great deal of good in educating young men who have to teach school as a means of advancing themselves. It has attracted to the University a number of mature young men, who promise to make excellent scholars and teachers. It is gratifying to be able to report that the young men who have completed the course in this department are entering, with promise of success, upon the work for which they were trained. Every one of the nine students who completed the course last June is now actively engaged in teaching. One is the principal of a county academy and a County Superintendent, one is president of a local college, another is the principal of a city graded school, three are principals of village schools, and the others have good positions in schools of the best class. Nearly all of the other students in the department are teaching in the common schools at the present time.

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Respectfully submitted.

CHAS. W. DABNEY, JR.,
President.

In connection with the biennial report of 1892, from which the above extracts are taken, the latest catalogue at hand* continues the history of the development of the University. From this the following extracts are taken, showing the increase in the number of Departments, in the attendance of students, and in the facilities afforded for instruction in drawing, and in mechanical training.

THE TRUSTEES.

The Board of Trustees of the University hold a charter from the State dating from 1807. It is limited to thirty members, chosen from the different Congressional districts in the State, who serve for life, or until removal from the State, or resignation. The Governor, the Secretary of State, and the Superintendent of Public Instruction are members *ex-officio*. Seven members form a quorum. The President of the University is also President of the Board of Trustees; the other officers are a Treasurer and a Secretary.

DEPARTMENTS.

The University of Tennessee is an integral part of the public educational system of the State. As at present organized, it forms the capstone of this system, and completes the work begun in the common schools and carried on through the secondary and high schools. Its existence is due chiefly to the bounty of the United States, the largest portion of its income being derived from the proceeds of the sales of public lands granted to the several States by Act of Congress of July 2, 1862, and from the appropriations made by the Acts supplementary thereto.

The present organization of the College of Agriculture, Mechanic Arts and Sciences, is designated to meet the requirements of the laws which provided this foundation.

ACADEMIC DEPARTMENT.

This department includes:

I. The *College of Agriculture, Mechanic Arts and Sciences*, with the following Courses of Study:

1. General Course, including the literary and classical.
2. Course in Agriculture.
3. Course in Civil engineering.
4. Course in Mechanical engineering, including the electrical.
5. Course in Mining engineering.

Graduates in the General Course receive the degree of Bachelor of Arts if the ancient languages were taken; otherwise the degree of Bachelor of Science.

Graduates in the Agricultural, Civil engineering, Mechanical engineering and Mining engineering courses receive the degree of Bachelor of Science in Agriculture, Civil engineering, etc.

SCHOOLS.

I. School of Latin.
II. School of Greek and French.
III. School of English and German.
IV. School of History and Philosophy.
V. School of Mathematics.
VI. School of Civil Engineering.

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* University of Tennessee. Register for 1892–93, and Announcement for 1893–94. Knoxville, Tenn.: Published by the University. Press of Newman & Co. 1893. Pp. 72.

VII. School of Physics and Electrical Engineering.
VIII. School of Mechanical Engineering and Drawing.
IX. School of Mechanic Arts.
X. School of General and Analytical Chemistry and Metallurgy.
XI. School of Organic and Agricultural Chemistry.
XII. School of Agriculture.
XIII. School of Botany and Horticulture.
XIV. School of Zoology.
XV. School of Military Science and Tactics.

Connected with and forming a part of the Academic Department, is a Teachers' Department, designed to train teachers for the public and private schools of the country. Students who complete the course required receive a certificate with a license to teach in Tennessee.

The requirements of the Code (Section 339) that "the accommodation and instruction of persons of color shall be separate from the white," is met by providing corresponding "accommodation and instruction" in the Industrial Department of Knoxville College, in Knoxville, for colored students who pass the required examinations and receive appointments.

II. The *University Department.*

1. With courses for the graduate degrees of M. A., M. S., and Ph. D.
2. With professional courses leading to the degrees of C. E., Min. E., and Mech. E., and elective courses for special students.

PROFESSIONAL DEPARTMENTS.

1. A Department of Law, with a course leading to the degree of B. L.
2. A Department of Medicine, with a course leading to the degree of M. D.
3. A Department of Dentistry, with a course leading to the degree of D. D. S.

FACULTIES.

A separate Faculty has charge of the instruction in each department. The Faculties consist of a dean, professors and associate professors, and aided by lecturers, instructors, fellows and assistants.

The University, as a part of the system of public education of the State, is authorized to receive three hundred and sixty-six State scholars. These scholarships are awarded throughout the State, ten to each Senator and three to each Representative in the General Assembly. "These State scholarships secure the holder free registration and tuition until graduation or dismission." All State secondary schools are, by law, "accredited schools." These were established by the law of March 25th, 1891. These have a course of eight years; three years more than the primary schools. The studies to be pursued are stated in the law. The graduates, under stated conditions, are to be admitted to the University. There are, also, "scholarships," "apprenticeships," and "fellowships," connected with the University and carrying certain privileges and incomes; much space is given in the Register to the details relating to them. As it would be impossible to give full details of all the institutions included in this volume, that is in no case attempted; though much more of detail is given in many cases than would be admissible if the rule to confine the accounts only to what relates to drawing, and mechan-

ical or art training, were rigidly enforced. The main purpose is to give the facts relating to these branches as fully as may seem desirable and, also, to show the development in modern educational methods and facilities, that has taken place during the years since 1880. The following brief showing of the location and equipment of the University is from the full and detailed account given in the Register:

LOCATION.

The University is situated in the suburban town of West Knoxville, one-half mile from the Custom-house, the center of the city of Knoxville.

Its location, eleven hundred feet above the sea, in the mountains of East Tennessee, is unsurpassed for healthfulness and beauty. The twelve large buildings stand in a beautiful campus of forty acres, covering a high hill on the north bank of the Tennessee river. They command a view of the valley of the Tennessee river, from the Smokies to the Cumberland mountains, a distance of one hundred miles.

The University has a complete system of drains and sewers and all the improved sanitary arrangements. The public buildings, dormitories and grounds are lighted with incandescent electric lights, operated from the Mechanical department.

BUILDINGS.

There are eleven large brick and stone buildings in the beautiful campus of forty acres, three of them new.

The Science hall contains the auditorium, President's offices, the library, reading room and seminary room, the laboratories of Chemistry and Physics, and the drawing rooms and lecture rooms of the schools of Civil engineering and of Mechanical engineering.

There is a fine library and very complete laboratories to the uses of which twelve apartments in the new Science building are given.

MECHANICAL DEPARTMENT.

The present equipment of the School of Mechanic arts occupies two floors of a building about eighty-four by forty feet, which was erected especially for this purpose. The whole of two floors is occupied by machine shops.. A large one-story annex contains the blacksmith shop and boiler room. The third floor is occupied by drawing-rooms, a blue print room, a store room, a laboratory, and an office.

There are two wood-working shops. The first of these is furnished with benches and lockers for tools for carpentering and joining. The second room contains ten speed lathes for wood-turning, with a full set of tools for each lathe, kept in convenient reach on a tool rack. The tools are those required for turning and boring light work.

All the heavier power machines for wood-working are placed in another room on the ground floor. They form a complete set for reducing lumber from its rough state to finished pieces of any kind, ready to be used for pattern-making, cabinet work, or carpentry. Connected with the wood-shops is a drying kiln.

The blacksmith shop has six power blast forges. A full set of tools for light and medium work is provided for each forge. The smoke is drawn away from the forges by a large exhaust fan. Suitable benches and blacksmiths' vises are also provided.

The machine shop is fitted up with twelve benches and vises for use in chipping, filing, and the general work of fitting together the various parts of a machine. There is also an outfit of all the tools needed for the general work of the machinist.

These tools are also of the newest and best designs of workmanship. They were selected with a view to showing all the general and more important special methods used in iron working. They include engine and speed lathes, planer, shaper, heavy and sensitive drill presses, universal milling machine, universal reamer and milling cutter grinder, and emery tool grinder.

Power is furnished by a forty-horse-power Sweet straight line engine and a boiler, the latter located in an annex. The engine runs all the machines and a dynamo for experimental purposes during the day, and at night is belted to the Edison dynamos in the same room for lighting and experimenting, which light the University buildings and grounds. The boiler, beside supplying steam to the engine, heats the building and drying kiln by either direct connection with the heating coils, or with exhaust from the engine.

The Department is well supplied with steam gauges, engine-testing apparatus, volt-meters, ampere-meters, resistance boxes, and other test instruments for electrical engineering.

FARM.

The School of Agriculture has a beautiful and well stocked farm of over one hundred acres, with experimental dairy, stables, silos, root cellars, etc. The Agricultural Experiment Station affords many advantages for scientific students. In addition to the laboratory work of the Station, many experiments are in operation in the green house, on the horticultural grounds, on the farm, and in the stables. A first-class working herd of Jersey and Holstein-Friesian cattle, each, belongs to the farm.

The gymnasium is completely equipped with the best apparatus, baths, lockers, etc.

Before quoting the account of the Schools of Mechanic Arts, etc., from the Register, the report of the Superintendent of the School of Mechanic Arts, given in the Biennial Report of 1892, is inserted, as giving a clearer view of the methods of instruction.

IX.—School of Mechanic Arts.

Dr. Charles W. Dabney, Jr.,
President University of Tennessee:

Dear Sir: I have the honor to submit the following report of the School of Mechanic Arts:

EQUIPMENT.

Since the last report, several valuable additions have been made to this department, though the accommodations are still insufficient to meet the requirements of the rapidly increasing number of students. This is particularly true of the newest branch—the machine-shop—which has been improved rapidly, especially in the last year. Every new article added, however, has been of the best type in the market, a rule which seems to have been the motto of the department since its start, and, as a result, the whole equipment is first-class in every respect.

Wood-shop.—This department is well equipped to give instruction to a moderate number of students. The carpenter's shop is supplied with twenty-six sets of tools, each with a good bench, bench-stop, and Massey vise. The benches are so placed as to economize space, and, at the same time, give good arrangement for light and convenience. The tools are in cases so constructed that when open each tool is in easy reach of the student. The power machines of the wood-working department consist of a planer, combination rip and cross-cut saw, jointer, sharper, jig-saw, borer, mortiser, roll-turner, and nine wood-lathes. Others are available when needed.

Blacksmith shop.—This shop is furnished with six Buffalo forges, each supplied with a complete set of the ordinary blacksmithing tools, many of which have been made by the students. By means of blast and exhaust fans, each forge is given a blast from below and a forced draught above.

Machine-shop.—This branch has an excellent equipment for the instruction of a limited number of students. In it are found all the tools and machinery essential for the construction of a great variety of other articles, tools, and machinery of practical and commercial value. The power machines consist of a planer, shaper, two lathes, drill press, milling machine, universal tool grinder, sensitive drill press, and emery grinder; also good sets of reamers, taps, dies, drills, scrapers, surface plates, etc. Heavy benches, supplied with good vises, are placed in position for light and convenience.

A large new lathe and some additional apparatus for making engine tests have just been ordered.

The engine is a 40 horse power Sweet Straight-Line, and, with the boiler, of like size, is used for the shops by day, and the electric light plant by night. The heating of the building can be accomplished either by live steam, direct from the boiler, or by the exhaust steam from the engine.

INSTRUCTION.

Wood-working.—The student starts with a complete exercise with each individual tool, and, having become proficient with each, he then takes up a complete set of joints, splices, dovetails, etc., such as are met with in actual construction work, bringing into constant use many, if not nearly all, of his tools. The hand and eye are now trained to undertake more difficult work, and he passes to turning, pattern-making, cabinet-work, and the polishing of woods, all of which give him a thorough familiarity with the power machinery in cutting, dressing, and shaping his material. The aim is to make the course as practical as possible, in the construction of useful articles, such as models for the drawing department, patterns for castings which will be actually used in the machine shop, and cabinet pieces for this and other departments of the University.

Blacksmithing.—Starting with the management of his fire, the handling of his tools, and the general manipulation of his forge, the student takes up various exercises in forging, so graded that the more difficult ones follow the simpler, and will involve thorough practice in welding the various grades of iron and steel. Special attention is paid to the forging of tools and tool-dressing. The larger portion of the lathe, planer, and shaper tools for the machine-shop have been made by the students in this department.

Machine-shop Practice.—The student now reaches the last department of his manual training, and he finds in entering upon his two years here that all the skill which he has acquired in the other departments comes into play, and he enters at once upon exercises demanding the greatest of accuracy. Commencing with thorough practice in vise work, he progresses, step by step, from chipping, filing, and scraping to careful and particular exercises on each machine tool; and, when he has proved himself competent, he enters upon the construction of some actual tool or machine. Care is taken to so distribute his work that he will have a great variety of exercises, involving every machine under the different conditions. A great many tools, gears, a small engine, and other articles have been made by the students in this department. They are now working on a working-model engine, both of which were designed in the Mechanical Department. They are also building a Mather motor, and will soon start on an iron-bed wood-lathe, a twist-drill grinder, and a planer tool-testing apparatus.

The only branch the student does not get instruction in, is foundry work; but it is hoped that this department will soon be added, so that the transformation of the

rough commercial material to the finished machine will be placed entirely in his hands.

The complete course of manual training is taken by the mechanical and electrical engineering students; but those of several other courses take as much as their time will permit. The course is not designed to make a tradesman or artisan out of the student, though he will be able to take up any of the branches with profit; and whether he be an agriculturist or a lawyer, a mining engineer or a business man, the training thus acquired will aid him in either doing his own mechanical work or knowing that it is correctly and economically done when placed in the hands of others. But the main purpose of the course is intended, rather, to fit him for designing and overseeing, for this practical training, taken along parallel with his theoretical, has made him capable of putting his ideas into practical form, and, having once been through similar work, he is equipped to meet intelligently the problems of construction.

Respectfully submitted.

J. R. McColl,
Acting Superintendent of Shops, in charge School of Mechanic Arts.

VIII. School of Mechanical Engineering and Drawing.

Professor to be elected; Mr. Ferris.

I. DRAWING.

The instruction and practices in drawing extended throughout the various classes of the engineering courses. The Freshmen are instructed for one term in free-hand drawing and linear perspective. The work in the upper classes is arranged to suit the course of study which the student is pursuing, or the object which he has in view.

1. Free-hand sketching of models, patterns, pieces of machinery, etc., linear perspective; Freshman class, all courses, first term for Engineering courses; second term for General course, three periods a week.
2. Drawing begun; Freshman class, engineering courses, three hours a week the second term. The class becomes familiar with the use of drawing instruments, in making tracings of standard types of machines and in making detail working drawings to scale.
3. Mechanical drawing; Junior class, engineering courses, three periods a week, throughout the year. The work consists largely of making detail working drawings of standard types of machinery.
4. Machine designing; Senior class, Mechanical engineering course, three periods a week, throughout the session. Original designs of various parts of the steam engine, pump, etc.

II. MECHANICAL ENGINEERING.

1. Descriptive Geometry; Sophomore class, engineering courses, three periods a week, second term. A theoretical study of the subject, together with a number of practical examples, of which drawings are made under each head.
2. Kinematics; Junior class for Mechanical engineering course, second term, three hours a week. The geometric principles of machines and relative motion of the different parts, as the link-work, cams, gearing, and belting; the relative motions of pistons and cranks, eccentrics and valves, etc.
3. Materials of construction; Senior class, Civil and Mechanical engineering courses, second term, three hours a week. The origin, nature, method of preparation and useful properties of the common metals and other materials used in engineering structures, and their strength, elasticity and other essential qualities.
4. Prime movers; Senior class, Civil and Mechanical engineering course, first

term, two hours a week for the civil engineers, with an additional three hours a week for the mechanical engineers, during the second term. In this course the various boilers and engines in use, together with the various link and valve motions, the indicator and its applications, and the proportioning of the different parts of the engine, are studied.

IX. School of Mechanic Arts.

Mr. McColl, *Acting supt.;* Mr. Guinn, *foreman Machine shop.*

The object of this School is not to train mere artisans, such as carpenters, pattern-makers, blacksmiths and machinists, but to educate engineers who will have that practical knowledge of the essentials of all construction which will qualify them to direct such work intelligently and to judge as to its proper execution.

The staff of the School of Mechanic arts consists of a superintendent, a machinist, a blacksmith, a day engineer and a night engineer. The latter is in charge of the dynamos and electrical apparatus.

The regular course in Mechanic arts begins with the first term of the Freshman year, and extends, with the exception of the last half of the Sophomore year, through the whole four years of the Mechanical and Electrical engineering courses.

1. Wood-working: Exercise with hand tools and turning lathe; Freshman class, fall term, for all courses, except the General, three periods a week. (These periods are at least two hours each.)
2. Wood-working: Care and use of power tools, including those for sawing, planing, jointing, shaping, moulding, boring and mortising, as required for pattern-making and cabinet work; Freshman class, spring term, for the Agricultural, Civil, Mechanical and Mining engineering courses, three periods a week.
3. Iron-working: Exercises in forging, welding, and tempering; Sophomore class, fall term, for the Agricultural, Mechanical and Mining engineering courses, three periods a week.
4. Iron-working: Exercises in the use of hand and power tools in the machine shop; Junior class, for the Mechanical engineering course, three periods a week, throughout the year.
5. Machine construction, requiring general use of machine tools; Senior class, fall term, for the Mechanical engineering course, three periods a week.
6. Expert, work bringing into use all skill acquired in the various branches of shop-work; for the Senior class, spring term, six periods a week.

The following is the account of the Department of the University which is given to the education of the colored youth of the State who desire University training:

Industrial Department at Knoxville College.

The statutes of the State of Tennessee (see The Code, Art. IV., Sec. 339) direct "that no citizen of this State otherwise qualified, shall be excluded from the privileges of the University by reason of his race or color; but the accommodation of persons of color shall be separate from the white." The Board of Trustees of the University have for many years met the requirements of this clause by providing similar instruction, modified to suit the requirements of the students of this race, in a separate department.

The Industrial Department of Knoxville College, located at Knoxville, Tennessee, is the colored department of the University of Tennessee.

The Board of Trustees of the University elect the instructors and pay all the salaries and current expenses from the Land grant income and additions thereto. The President of the University and the Professors of Agriculture and Mechanic arts have immediate supervision of the course of study, the equipment and the

methods of instruction there used. This is a department of the University, like any other.

This institution has a complete outfit of buildings, a full faculty and a fine equipment for giving instruction in the usual college branches. A new building was erected last year for the laboratories and shops of this department. There are shops for work in wood and iron, drawing rooms, and laboratories for chemistry, botany and agriculture. The building is equipped with a boiler and engine, and the necessary machinery and tools. The laboratories have a good outfit of apparatus. A tract of land immediately adjacent to the building is provided for practical work in agriculture and horticulture. Separate instructors in chemistry, botany and agriculture, and for drawing, mechanic arts and physics are provided for this department. All of the work in it will be under the supervision and direction of the President and Board of Trustees of the University, as are the other departments.

Students in this department receive State scholarships under the same regulations as other students. The Board of Trustees have created twelve separate apprenticeships in this department, worth fifty dollars per annum each, to be awarded to the most meritorious and promising students in the regular industrial courses. These apprenticeships will be awarded by the President of the University, upon the recommendation of the President of Knoxville College. They secure work in the shops and on the farm of the department, the service required being rated at its market value.

COURSE OF STUDY.

State Students must be prepared to enter the Second Year's course.

Agricultural course.	*Mechanical course.*
FIRST YEAR.	
Arithmetic.	Arithmetic.
English.	English.
General History.	General History.
Farmwork.	Drawing; Shopwork.
SECOND YEAR.	
Elementary Algebra.	Elementary Algebra.
Rhetoric.	Rhetoric.
Physiology.	Physiography.
Physiography; Agriculture.	Drawing; Shopwork in Wood.
THIRD YEAR.	
Higher Algebra.	Higher Algebra.
Language.	Language.
English Literature.	English Literature.
Botany; Agriculture.	Drawing; Shopwork in Iron.
FOURTH YEAR.	
Geometry.	Geometry.
Zoology.	Chemistry.
Political Economy; Logic.	Political Economy; Logic.
Agriculture.	Designing; Shopwork.
FIFTH YEAR.	
Natural Philosophy.	Natural Philosophy.
Agricultural Chemistry.	Trigonometry.
Geology.	Care of Engine and Machinery; Construction.
Experimental Farm Work.	

Lectures and readings on the studies of each year in the Course. The graded course in shopwork is taken up as the student is prepared and masters the various subjects, according to the judgment of the professor in charge.

For detailed information with regard to courses of study, expenses, etc., see the separate catalogue of this department. For this apply to the President of the University, or to Dr. J. S. McCulloch, President of Knoxville College, Knoxville, Tennessee.

Summary of students in the Academic Department.

Sub-freshmen	15
Freshman Class	77
Sophomore Class	61
Junior Class	20
Senior Class	19
University and Special Students	47
State Appointees at Knoxville College	27
Total in Academic Department	266
Total number from Tennessee	239
Total number from other States	27

SUMMARY BY COURSES PURSUED.

1. *Collegiate courses.*

	Sub-freshman.	Freshman.	Totals.
Latin-Scientific	14	28	42
Classical	1	13	14
Agricultural and Scientific		36	36

	Soph.	Jun.	Sr.	Totals.
Latin-Scientific	20	3	8	31
Literary-Scientific	14	4	3	21
Civil Engineering	5	4	3	12
Mechanical Engineering	11	3	1	15
Mining Engineering	1	3	3	7
Classical	4	3	1	8
Agricultural	5			5
Electrical Engineering	1			1
Total Agricultural and Scientific				36
Total Classical				22
Total Latin-Scientific				73

2. *University courses.*

Agricultural	1
Chemistry	2
Civil Engineering	2
Greek	1
History and Political Science	1
Languages and Literature	4
Latin-Scientific	2
Literary-Scientific	1
Mechanical Engineering	2
Sciences	3
Teachers' Course	29
Counted twice	1

Résumé.

Students in the Academic Department:	
1. College students	219
2. University and Special students	47
Total number in the Academic Department	266
Professional Departments:	
3. Law Department	7
4. Medical and Dental Department	269
Total number of students in the University of Tennessee	542

The Faculty of the Academic Department of the University number 21. Charles W. Dabney, Jr., PH. D. (Gottingen), LL. D., President of the University (1892–93).

THE AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS. COLLEGE STATION, BRAZOS CO., TEXAS.

This college was established by the Legislature of Texas in accordance with the United States Law of 1862, the provisions of which were formally accepted by the Legislature November 1st, 1866. The act establishing this college became a law April 17, 1871.

By a provision of the State constitution of 1876, this college was made a branch of the proposed University of Texas, "for instruction in agriculture, the mechanic arts and the natural sciences connected therewith."

The county of Brazos, to secure its location, gave to the State, for the use of the college, a tract of 2416 acres of land, lying five miles south of the town of Bryan. The Houston and Texas Central Railway passes through the grounds and the post office address is College Station.

The legislature made successive liberal appropriations for erection of buildings and purchase of apparatus; aggregating in 1881, the sum of $202,000. The college was formally opened for reception of students October 4th, 1876, with an attendance of six students; which however rapidly increased. The military feature of the college attracted great attention; and the second year, there was an influx of 250 students, with only accommodations for 150. The buildings, when fully completed, were designed for an attendance of 250; but the applicants soon far exceeded this limit.

The permanent trust fund arising from the land grant was $174,000; invested in 7 per cent State Bonds. A definite number of State students are boarded and taught free of cost. The purpose in founding this college, as the address delivered June 26, 1877, by the Hon. A. J. Peeler, of Austin, Texas, one of the State Directors of the college, distinctly shows, was that of training up for the great State of Texas, from among her own sons, the engineers, men of science, architects, scientific agriculturists, and practical mechanical constructors, that were already, and must soon be more and more, in demand. This admirable address shows a broad and far-reaching comprehension of the needs of the community for thoroughly trained scientific men, as well as a true conception of the proper work of such an institution as was intended by the act of congress, which, while not opposing classical or literary culture, sought to build up, either in conjunction with classical colleges, or separately, institutions giving scientific training in agriculture and the mechanic arts.

It was soon felt that the literary and military development of this college was disproportionate to that of the studies it was its special

province to teach, and the President, being required by law to annually report, President Jones, in his "fourth annual Report," under date of July 1st, 1880, discusses a plan of reorganization; and states the conclusions of the Faculty as to the desirability of modifying the studies and changing the courses from elective to prescribed. He, also, incidentally discusses the kind of education demanded. The topics he treats are of such interest in any consideration of higher technical industrial education, whether in institutions indirectly founded by the government, or not, and discriminate so clearly between the idea, once somewhat prevalent, that the Morrill law originally contemplated only manual labor farm schools, and had been unfairly wrested from its purpose; and the other idea, that all higher education must needs be of the classical type; that his conclusions are here quoted at some length; as bearing upon the general subject of the present work.

Comments by President Jones.

A little more than six months ago this institution was turned over to the present faculty, to mature by the end of the next session, a Plan of Reorganization. They found that it had been organized and conducted upon the university plan of elective studies, with the classics as its great central idea; that no systematic and practical instruction had ever been given in what the law commanded should be the "leading object"—agriculture and the mechanic arts; and that instead of popularizing the study of agriculture, horticulture, stock-breeding, and the mechanic arts, and thus fostering a juster appreciation of the dignity and the importance of these great industrial pursuits which must ever be the foundation of the state's material prosperity, the college had sedulously cultivated a sentiment antagonistic to the development of these branches of study, and which continually decried them. It was in spirit and in fact, as far as circumstances permitted, a strictly literary college—top-grafted with a strongly prominent military feature. That it should fail to secure its support in an intelligent public opinion, while thus conducted in the face of the mandatory legal enactments under which it was established and endowed, is not to be wondered at.

The Morrill bill explicitly requires that the interest of the endowment fund "shall be inviolably appropriated by each state which may take and claim the benefit of this act, to the endowment, support and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislature of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits in life."

THE STATE ACCEPTED THE PROVISIONS OF THE U. S. LAND GRANT LAW OF 1862.

Our state received the benefit of that act by accepting, in 1866, its provisions, and establishing, in 1871, the Agricultural and Mechanical College of Texas. And, to leave no doubt as to the real object of the college and its true relation to the educational system and industrial interests of the state, the constitution of 1876 declares:

Section 13. The Agricultural and Mechanical College of Texas, established by an act of the Legislature, passed April 17, 1871, located in the county of Brazos, is hereby made and constituted a branch of the University of Texas, for instruction in agriculture, the mechanic arts, and the natural sciences connected therewith.

With marked liberality the state has equipped the college with commodious buildings, a well stocked farm, laboratories, apparatus, instruments, means for purchasing tools and machinery, and all else necessary for complying with the intention of the law; but it has made no provision for prominently developing the literary side of the institution either by adding to the endowment fund, or paying the salary of a single professor. Simple honesty, therefore, requires that the trust imposed by the act of Congress, (and Texas is a bound trustee in the matter,) should be strictly discharged, and that, without excluding purely literary studies, the main stress of the teaching and influence should fall upon the technical branches specified. There is already a wide demand in our state for just such scientific and practical industrial education, and if there exists a demand equally as wide for a broader and more liberal literary and professional culture than existing colleges within our limits can supply, then the time has come for the establishment of the State University; it has an ample endowment fund already provided. For this college to do thoroughly and usefully its own distinctive work will tax to the uttermost its present limited resources in money and instructors.

ILL RESULTS WHEN THE LAND GRANT COLLEGE IS MADE SIMPLY AN ADJUNCT TO A CLASSICAL COLLEGE.

Nearly every state in the Union has taken advantage of the Morrill act. In many the attachment of a so-called agricultural department to an existing institution was deemed a compliance with the law. The result in every instance almost has been a disastrous failure, due to the overshadowing influence of the literary features. Over fifty colleges have received this endowment, and of them all, the only ones which have proved eminently successful are those which were organized and conducted as separate and independent colleges, for the purposes specified in the act, and for no others. And this is very pointedly put by President William Johnston, of the Ontario School of Agriculture, who in his report on Agricultural Education in Germany and the United States (1873), to the Hon. Commissioner of Agriculture of Ontario, Canada, thus accounts for the failure of so many of our agricultural colleges: "The great faults of the majority of them are the attempts to teach too many subjects superficially; to give too many optional courses, to leave out a course of farm apprenticeship, and to make their curriculum too literary and not sufficiently technical."

I deemed it proper to call your attention, in this connection, to the following action of the United States Senate in March last:

Resolved, That the Secretary of the Interior is directed to furnish to the Senate such information as is in the possession of the Bureau of Education in relation to the state of technical or industrial education in the schools and colleges endowed in whole or in part by the government of the United States, and also in other schools and colleges in the several states and territories and the District of Columbia, and the extent to which provision has been made for the education of females in technical and industrial branches of education and the number of females in attendance at said schools.

To the official demand made upon me for information concerning this college I returned such answers as the facts warranted, and I regret that they could not show the technical and industrial side of the college in a more creditable condition.

The Faculty have unanimously instructed me, therefore, to recommend that the present elective system of studies be abolished and that there be substituted for it a well arranged curriculum, four years in length, and embracing, besides such other studies as your Board may prescribe, English Language, History and Literature; Scientific and Practical Agriculture: Horticulture; Stock-Breeding, and Veterinary Science; Animal and Vegetable Physiology and Anatomy; Physics; Chemistry; Mineralogy and Geology; German Language and Literature; Philosophy and

Political Economy; Mathematics; Land Surveying and Leveling; Civil Engineering; Mechanics; Drawing; Book-Keeping; Physical and Descriptive Geography, Elocution, Declamation and Composition; Military Tactics.

To this curriculum optional courses in the Latin and Spanish languages should be added—the demand which already exists for them being quite large, and they are too important to be omitted. But it is recommended that Greek and French be no longer taught. Should Greek be discontinued, it is respectfully suggested that the present course in Philosophy, including Logic, Mental and Moral Philosophy, and Political Economy, be given to the Professor of Ancient Languages, and that his department in future be designated the chair of Latin and Philosophy.

The course of instruction recommended, while it makes prominent the scientific and technical features, affords at the same time ample facilities for literary culture, and, indeed, requires a large amount of it as an essential for graduation.

THE INDUSTRIAL DUTIES.

The success and usefulness of this institution as a school of Applied Science will very largely depend upon the tact and ability with which the practical duties in the technical departments are arranged and enforced. There should be no misconception as to the object, nature, and intent of these duties. They should occupy to the theoretical courses of Agriculture, Horticulture and Mechanics, relations analogous to those sustained by the laboratories, field-work and draughting, and dissecting room to the courses in Physics and Chemistry, Engineering, and Anatomy respectively—and without these practical supplements no course can be made valuable. The nature and extent of the labor to be performed must be left necessarily, under some general restrictions imposed by the Board, to the discretion and experience of the Professors of Agriculture and Mechanics, who are to be directly responsible for the success of their departments. The field and shop duties will not come every day, but will take their regular place in the round of practical work which includes also laboratory practice in Physics and Chemistry, field-work in Surveying and Leveling, Draughting and Designing, military drills, Animal and Vegetable Physiology and Anatomy, and Veterinary Clinics. They will not be intended to give mechanical skill in field operations to the student but to make him an intelligent applyer of the laws and principles of nature on the knowledge of which scientific agriculture and horticulture are based.

INDUSTRIAL DUTIES SHOULD BE COMPULSORY.

To the question: Shall these duties be voluntary or compulsory? my humble judgment deliberately and unhesitatingly replies that they should be compulsory. First, *on social grounds;* as all students under the proposed curriculum will be required to study the science of agriculture and mechanics, so they should also be required to make the necessary practical applications with their professors in the fields and the shops; otherwise, there will inevitably arise in the college a species of caste, in place of that homogeneity of feeling which should bind all its members into a close fellowship, and which, in my judgment, will soon destroy the efficiency and influence of the technical departments, however lavishly money may be spent in their equipment. Second, *on the ground of utility:* The courses, if taught at all, ought to be made of some value to the student and to the state. The student of agriculture should be made as familiar as possible, not with books only, but with the actual soils, manures, crops, and implements themselves, and should see and participate in, as far as practicable, the best methods of culture and preparation. The student of horticulture must learn how to plant, cultivate, prune, bud, and graft fruit-trees and vines, not in the lecture room, but in the college orchard and vineyard, under the professor's practical instruction. And the student of mechanics should see,

handle, and use the tools and machinery which are necessary for the applications of the principles of mechanism and construction, studied in the text.

THE COLLEGE SHOULD NOT BE A "MANUAL LABOR SCHOOL."

As I said in my report of March last: All work will be carefully performed under the guidance of the instructors, who will systematically enforce attention to principles as well as practice, and thus make the exercises a mental discipline no less than a training for eyes, hand and muscles. *But no attempt should be made to convert this into a manual labor school*, in the popular acceptation of the term, in which the student is to be turned into a veritable field hand or mechanic, and his work received as a full compensation for board and tuition; no college can do this and make its academic course of any value. The practical work should be regarded solely as a part of the regular instruction, which, in after life, may be valuable to the student, whatever his profession.

In other words, just as the professor of Chemistry *compels* his class to go with him through the practical and experimental part of the course in his laboratory, so the professor of Agriculture ought to be allowed to require *his* class to go with him through the practical and experimental parts of *his* course in *his* laboratories, the farm and orchard. This labor, being simply instructive and for the student's benefit, should, of course, be without remuneration.

The Fifth Annual Report by the President, for 1880–'81, shows that a rearrangement of the courses has been adopted. The plan of instruction consists of an Agricultural course and a Mechanical course each of three years. All students must enter one or the other. The classics are optional studies.

The studies of the first year are the same, in the English branches and mathematics; but the agricultural books and farm practice, are given in the one, and Free hand drawing and shop practice, in the other. Drawing in all its industrial forms, and direct shop practice, run through the succeeding two years of the Mechanical course.—Drawing does not appear in the schedule of the Agricultural course.

The President announces that a building has been fitted up with suitable tools for wood and metal working.

The following extracts from the report of Professor Van Winkle, in charge of the "Department of Mechanical Engineering and Drawing," set forth the purpose of the new departure and the course of training:

DEPARTMENT OF MECHANICAL ENGINEERING AND DRAWING.

President J. G. JAMES:

SIR: I have the honor to submit herewith a report of the organization, work and condition of the Department of Mechanical Engineering and Drawing for the session of 1880–'81. In organizing this department due consideration was paid to—

The wants and resources of the State.

The character of student material to be dealt with.

The appliances requisite for giving such a course of practical and theoretical instruction as would be most beneficial to the community and consequently most valuable to the graduate.

The urgent and increasing demands of the State are for skilled artisans—those who are able to do good, practical work, or take positions in manufactories and

other mechanical pursuits as superintendents and foremen—whether in the construction and operation of railroads, cotton and woolen machinery, or building of structures and machines for developing our natural resources.

The immense water powers of Texas should be turned to good account in driving thousands of spindles and looms. Capital, dormant or invested abroad in similar enterprises, is ready to lend its assistance in preparing our staple products for the large and growing demands of home consumption. But the State is almost entirely dependent upon foreign skill and labor in the mechanical pursuits, and the comparatively few enterprises already in existence are crippled and stagnated. The importance of the problem is fully appreciated, and it is incumbent upon us to find a speedy solution. The novelty of this course of instruction may require an exposition of its objects, which being clearly understood, will serve as the best explanation of its details, viz: To give a good education based on mathematics, physical sciences and drawing, and a sufficient familiarity with their practical application in the mechanic arts to secure to the student a livelihood and to the State a valuable member of society in exercising and disseminating his technical knowledge.

The scope of a single trade is too narrow for purposes of instruction by classes: moreover, there are certain principles underlying them all. The great variety of tools used in mechanical processes of the present day are only combinations of a few elementary hand-tools. All pupils should, therefore, take the same course of elementary instruction, after which, encouragement should be given in those special branches for which they show an aptitude. Students possess different talents to be developed—some exhibiting a tact for drawing and designing, others for directing operations or for mechanical manipulation; but, to be proficient in any industrial branch, a thorough knowledge of all pertaining to it is as essential to the director as to him who actually frames the house, bores the steam engine cylinder, or builds the structure or machine. Each must not only be familiar with his own work, but know exactly what to expect from those connected with him. In order to intelligently direct others, he must know their capabilities; to follow the directions of others he must know how to interpret and supply their wants. For practical instruction the student requires only physical strength and common sense. But text-books on mechanical subjects employ principles of mathematics, physics and chemistry, as well as those of practice. Instruction in these branches must, therefore, precede theoretical or text-book mechanics. Thus arranged, the practical value of the course is directly in proportion to the time spent. The student feels this, and is prepared to receive his theoretical training with higher appreciation and broader criticism.

THE COURSE.

The course of instruction is in three parts, viz:

Practice.—Shop work and mechanical laboratory.

Drawing.—Free-hand, geometrical and mechanical.

Theoretical.—By lecture and text-book.

In the shops practical instruction is given—first, in elementary construction, that the pupil may acquire a most intimate knowledge of practice and skill in the use of tools and work-shop appliances. He is conducted through the shop exactly as though assuming the lowest place in a manufacturing establishment, successively filling higher positions, until finally graduated as superintendent. Practical instruction is never carried to the extent of weariness or drudgery, but is, on the contrary, a pleasant transition from study and recitation. All work is executed after drawings to which it must conform. Beginning with exercises in framing and joinery by use of hand-tools, the pupil is promoted to the use and care of wood working machinery, such as circular and fret saws, the turning lathe and exercises in pattern making. He is then made tool and stock clerk and timekeeper, thus famil-

iarizing himself with any special tools which may have escaped his notice in the wood department, and becomes acquainted with makes, sources and prices of the shop equipment. He then takes a course of filing, chipping, screw cutting with taps and dies, and other vise work, and erecting of machinery; is then put in charge of the boiler, whence he is duly promoted to engineer to take charge of the power and its transmission. This is followed by a course in drilling, boring, turning lathe, screw-cutting and other machine tool work.

The above, including the bulk of shop practice, covers the first two years of the course, which, together with the preparation in other departments of the college, has laid the foundation for a course in Mechanical Engineering and laboratory practice. Beginning in the third year, lecture room instruction is given in the following subjects, the practical illustrations of which, together with the students' specially elected line of work, forming the basis of practice in the junior and senior years:

General properties of building materials.

Experiments on strength of materials.

Masonry, framing.

Bridges, roofs, roads, railroads and river improvements.

Iron, kinds of—manufacture of wrought and pig—mechanical properties.

Steel: kinds and how made, uses and how worked.

Shafting and transmission of power.

Study of construction and operation of steam engines; original essays and criticisms of machines and structures of various kinds throughout the course.

Special study of construction of locomotive—from complete set of original working drawings—grist mills, cotton mills and machinery—silver mills—plantation machinery, railroad equipments.

DRAWING.

is the short-hand language of modern science. It is a universal language, common to all men, showing at a glance what words would be inadequate to express, and is indispensable to the mechanic and engineer. The course begins in the first year, embracing lettering (free hand) sketching, geometrical problems and construction (with instruments), plotting of surveys and level section of drawing and elements of machines. In the third and fourth year elements of mechanism. Descriptive Geometry, Shades, Shadows and Perspective; drawing of original designs for machines and structures, and drawing for graduating thesis.

The Sixth Annual Catalogue for session of 1881–'82, shows the new departments evidently well established. The following is the programme thus given:

DEPARTMENT OF MECHANICAL ENGINEERING AND DRAWING.

Professor FRANKLIN VAN WINKLE, M. E.

The aim of this department is the instruction of the pupil in the applications of the sciences to Engineering and the Mechanic Arts in a manner which will be thorough, practical and of direct utility.

Instruction is imparted by practice (in shops and drawing office) text-books and lectures.

The following subjects are taught:

I. *Mechanical Drawing.*—This subject is taught by lecture and text-book, and by practice, free-hand and with drawing instruments; and embraces free-hand sketching and shading of geometrical solids, and intersection of solids, lettering, sketching of farm implements, with dimensions; geometrical construction with instruments; drafting to scale, and architectural drawing, and drawing of constructions in wood;

projection of elementary pieces of mechanism; projectional drawing of machines and structures from sketches and measurements; drawing of designs for machines and structures; drawing for graduating thesis.

Text-Books: McCord's Mechanical Drawing, Lectures.

All drawings are original and not copied by the student.

Methods of reproducing and blue-printing are also taught.

Each student must provide himself with a set of drawing instruments. The cost will be about $8 for all that is required.

He will make his own "T" square and set squares (triangles) in the shops as part of his regular exercises there. Pencils, paper and ink can be obtained at the college book store at regular market prices.

II.—*Engineering.*—Instruction in this branch of the department is by text-book and lecture. Like drawing with shop work, the instruction here is made concurrent with shop work and drawing.

Theoretical instruction is practically illustrated and applied by the student for himself.

The subjects taught are:

Materials of Construction.—Their resistance with experiments on their strength, &c.

Masonry.—Foundations, walls, arches, &c.

Carpentry.—Framing, floors, roofs, &c.

Bridges.—Of stone, wood, iron, suspension, &c.

Roads.—Common, railways, and railway appliances.

Determination of formulæ for strength of beams and columns with verification by experiments; the steam engine and steam machinery, with practical experiments on college engine with indicator and dynamometer; special study of the locomotive, from complete set of working drawings, iron and steel as materials of construction.

The student to write a monthly essay in the department, and before graduation, to submit a thesis on approved subject, accompanied by drawings and shop work.

Text-Books.—Mahan's Civil Engineering, Fairbank's Elements of Mechanism, Bourne's Catechism of Steam Engine, Lectures. * * *

INDUSTRIAL DEPARTMENT.

Professors GEORGESON and VAN WINKLE.

Each student is required to labor ten hours a week throughout the session. The Agricultural students, in the fields, orchards and gardens; the Mechanical students, in the shops. * * *

SHOPS AND SHOP WORK.

F. M. GILBERT, *Foreman.*

The Mechanical Department occupies a two-story wooden building, 84x34 feet, and two small attached rooms. In order to give systematic practical instruction it has been organized as follows:

1. Carpenter shop.
2. Forge shop.
3. Vise shop.
4. Wood-working Machine shop.
5. Metal-working Machine shop.
6. Steam Enginery.

Five thousand dollars have been spent for tools, machinery, 12 horse power engine and boiler, and materials necessary for a thorough equipment of these shops on a useful basis and the student, who will complete the prescribed three years' course of work in passing through them, will be well fitted for commencing life in some manufacturing or mechanical pursuit. As evidence of each year's proficiency, he will be expected to produce some piece of work of value and usefulness.

All shop work is executed from drawings furnished to the student, or made by him; he is instructed how to read and measure drawings to make free-hand sketches with dimensions of work in hand, and to make out correct bill of material from same before beginning his exercise with tools. All work must come up to the standard of good workmanship, before he is allowed to begin the next exercise or work. Students are held strictly accountable for the preservation and order of the tools or machines to which they are assigned, after having been taught how to put them in order.

Pocket callipers and a 24 inch rule are needed by each student; they can be gotten here.

Before any student in this department can graduate, he must place on exhibition some tool, implement or machine which he has made in the shops, and which has been pronounced satisfactory by the Professor of Mechanical Engineering.

There is shown a total attendance for 1881–'82, of 258 students; 59 Agricultural, 199 Mechanical, no students in last year of the Agricultural course, and only 4, in the second year.

LATER HISTORY.

The latest catalogue at hand* shows that the college is developing healthily, with a small increase in the number of students. The regular undergraduate course has been increased from one of three, to one of four years; and a Post Graduate course of two years added. In January, 1888, the Board of Directors established a Government "Agricultural Experiment Station", in connection with the college; in accordance with the law passed by Congress, in 1887, appropriating $15,000 a year, for the establishing of such stations in the several States.

The college has developed on the lines laid down in the reorganization, as given in the catalogue of 1880–'81. Its general purpose is thus stated in the present catalogue:

OBJECTS AND PRESENT POLICY.

The act of Congress which established the State Agricultural and Mechanical Colleges defines their objects, but under the act there have been founded as many different schools as there are States. These institutions have presented a variety of educational schemes, which have embraced nearly all gradations from the classical and mathematical college to the manual labor industrial school. In view of this fact, it is proper to state as definitely as possible the interpretation given to the act of Congress by the authorities of this college, and the manner in which they are endeavoring to carry out its provisions.

The general object of this college is to excite and foster in the minds of our people an enthusiastic appreciation of the attractiveness and value of those pursuits by which the material development of the country is advanced.

It proposes to equip boys for their future career by the fullest development of their powers with reference to the wants of life, and acquaint them thoroughly, both theoretically and practically, with the duty, the dignity and the nobility of labor. There is a great field opening in our State for practical technical employ-

* Seventeenth Annual Catalogue of the Agricultural and Mechanical College of Texas. Session 1892–'93. Railroad Depot, Express and Money Order office, College Station, Texas. Austin; Ben C. Jones & Co., State Printers. 1893. Pp. 79.

ment and a growing demand for the services of those fitted for labor in every branch of scientific knowledge, and we are now compelled to draw upon the skilled labor of other countries to fill the most lucrative, honorable and important positions in every industrial enterprise. In face of this fact, there can be no exaggeration of the value of an institution which will afford the direct advantage of conducting the student from the simplest mechanical principles to the complex order of artistic ingenuity by enabling him to combine principles, construct models and call into activity his ingenuity for designing; while a practical knowledge of the use of tools can be acquired in one-half the time necessary under the ordinary methods of obtaining a trade knowledge as an apprentice, kept at such work only as proves most profitable to the employer.

After discussing the value of scientific training in Agriculture and Horticulture, as tending to the development of self-reliant manhood in the students, and commending the military training, for the value of its exercises and discipline, both upon the health and the morale of the students; the business of the college is stated to be to turn the attention of the young men of the State, from the so-called "learned professions", to the scientific studies directly bearing upon the development of the material resources of the State.

These objects are sought to be obtained:

By a thorough course of instruction in all practical and useful branches of knowledge, with continual application of principles to work in the shops, fields, gardens, vineyards, orchards, pastures, dairies and other laboratories.

By relying upon text books as little as possible and leading the students to seek information directly from observation and experiment.

By inculcating the dignity of intelligent labor—banishing the idea that the farmer or mechanic who is worthy of the name need be any less learned than the professional man.

By inducing in the mind of the student an enthusiastic love of nature and the study of natural laws, whereby agricultural and mechanical processes become invested with absorbing interest, and are pursued in a spirit which leads to progress and success.

It will thus be seen that the authorities of this school adhere to the interpretation of the act founding it, which has been given by the author of this act, and which has been adopted by all the successful colleges of similar origin, namely: That this college is not a trade school, designed to take the place of the old apprenticeship system, but an institution where young men may receive broad and liberal training in all those sciences and arts which contribute to useful citizenship in the pursuit of all productive industries.

METHODS AND SCOPE OF INSTRUCTION.

The courses of instruction cover all that is comprised in the curricula of the best institutions of our times, except the ancient languages. The time usually devoted to these is here given to the application of the principles in the fields, shops, and laboratories. Mere text book study is regarded as comparatively of little value unless supplemented by intelligent practice in applied science. This practice occupies from six to eight hours per week.

EXPERIMENTAL WORK.

This furnishes the chief means of training students in accordance with this view, and hence a most important subsidiary object of this institution is the discovery and dissemination of all sorts of information with regard to industrial pursuits.

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REGULAR COURSES OF STUDY.

There are two regular courses of study and practice leading to degrees and extending through four years each. They are identical for the first year, thus giving the student the advantage of elementary training in subjects that are of equal importance to every one, and affording opportunity for intelligent choice between the courses as continued separately through the three succeeding years. In the third year, or second class, there is a still further specialization by which the student may, in the agricultural course, vary his studies with reference to obtaining either of two degrees, that is, Bachelor of Scientific Horticulture (B. S. H.) or Bachelor of Scientific Agriculture (B. S. A.). In the mechanical course a similar specialization is provided for by which the student is given choice between the degrees of Bachelor of Civil Engineering (B. C. E.) and Bachelor of Mechanical Engineering (B. M. E.).

All regular students must pursue either the agricultural or the mechanical course, and there is no course of instruction which is not industrial.

The languages are optional, except as shown in the curricula, and may be studied as subjects outside of the regular courses. There is no charge for any optional study.

In view of the great practical importance of the German and Spanish languages for business purposes in our State, special attention is given to these.

Post Graduate Courses are offered in the following subjects:

"Agriculture; Mechanical Engineering; Horticulture; Botany; Experimental Agriculture; Civil Engineering; Physics; Mathematics; Chemistry; Geology and Mineralogy; Modern Languages; English; and Drawing."

The following 12 "Departments of Instruction" for undergraduates are comprised in the College:

"English and History;" "Mechanical Engineering;" "Shops and Shop Work;" "Agriculture;" "Chemistry and Mineralogy;" "Mathematics;" "Veterinary Science;" "Military Science and Tactics;" "Civil Engineering and Physics;" "Horticulture and Botany;" "Languages;" "Drawing."

The courses in Mechanical Engineering and in shop work have been set forth in the previous pages and are substantially the same as are described in the present catalogue. The following extract gives the course in Drawing as it is given through the present four years course in the two main divisions of the College:

DEPARTMENT OF DRAWING.

Professor, F. E. GIESECKE, M. E.
Assistant, D. W. SPENCE, C. E.

The course of instruction given in this department extends through four years; the work of the different classes is shown in the following outline of the course of study:

FOURTH CLASS—*Penmanship and Free-Hand Drawing:* The lessons in penmanship tend to teach the student to write a plain and rapid business hand, by means of the muscular movement. The instruction in free-hand drawing is intended altogether as means of training the student's hand and eye, as well as his mind. The drawing books used are selected from Thompson's Primary and Advanced Free-hand Series.

Third Class—*Agricultural Course:* Free-hand drawing, one and one-half hours per week throughout session. Thompson's Advanced Free-hand and Model and Object Series are used.

Second Class—*Agricultural Course:* Mechanical drawing, two hours per week during spring term. This short course in drawing is given to enable the student to make the drawings necessary to his study and practice of surveying.

Third Class—*Mechanical Course:* Mechanical drawing, three hours per week throughout session. The student is taught the use of the drawing instruments in the drawing of simple figures, geometrical problems, and lettering during the fall term. During the winter and spring terms projection drawing is taught to prepare the student for the study of descriptive geometry. Practice in free-hand drawing is continued in this as well as in the two higher classes as an essential part of the regular work.

Second Class—*Mechanical Course:* Descriptive geometry three hours per week during fall, and two hours during winter term. Faunce's Descriptive Geometry is used as a text-book, and is supplemented by weekly original problems. Two hours per week during each term are devoted to drawing higher plane curves, gear teeth, screws, and various conventional signs used by draughtsmen. During the spring term the student makes working drawings of parts of machines which involve the principles he has studied in descriptive geometry. Those who take the B. M. E. course receive lectures on the materials used in machine construction during this term.

First Class—*Mechanical Course:* The drawing in the fall term will consist of exercises in tinting, tracing blue printing, and isometric projections. Applicants for the degree of B. M. E. will in addition receive lectures on machine designing, and will have practical exercises at the drawing board, during the winter and spring term, in designing and making working drawings of machine elements or of simple machines. Applicants for the degree of B. C. E. will be required to make a number of working drawings, general and detail, of such machines, buildings or structures as is thought advisable.

Equipment: The department is equipped with a good set of skeleton and solid models and plaster casts for free-hand drawing; a complete set of Schroeder's models for descriptive geometry, and a number of drawing instruments, which are only used occasionally. There are also provided for the students' use all necessary instruments, squares, and triangles, so that the materials only have to be purchased by the student. These can be obtained at the College book store.

The Catalogue gives copies of the Land Grant Laws passed by Congress, a brief summary of the different acts passed by the Legislature of Texas, and a copy of the existing State law, relating to the College; also, a copy of the U. S. law establishing the Experiment Station.

The following "Summary" shows the attendance during the Academic year 1892–'93:

Post graduates	4
First class	17
Second class	69
Third class	100
Fourth class	103
Total	293

Board of Directors.

The government of this College is vested in a Board of Directors, consisting of five members, appointed by the Governor of the State. They are "selected from different sections of the State, and hold office for six years, or during good behavior, and until their successors are qualified."

Hon. A. J. Rose, President.......................................Salado
Hon. W. R. Cavitt.......................................Bryan
Hon. John E. Hollingsworth, Commissioner of Insurance, Statistics, History, and Agriculture, *ex-officio*.......................................Austin
Dr. J. D. Fields.......................................Manor
Hon. John Adriance.......................................Columbia

The Board of Directors of the College are also the governing Board of the Experiment Station.

The "Faculty and Other Officers" number 31. L. S. Ross, is President.

The University of Vermont and State Agricultural College, Burlington, Vermont.

In 1863, the General Assembly of Vermont authorized the three classical Colleges of the State to unite in one State University, which was to be organized in accordance with the provisions of, and was to receive the income arising from, the United States Land Grant of 1862. This project failing, the Vermont Agriculture College was chartered in 1864, on certain conditions, not complied with. An act was therefore passed November 9, 1865, incorporating the State Agricultural College chartered in 1864, with the University of Vermont, which was founded in 1791. The act specifically directs that the University shall always maintain "such instruction in the various branches of learning as is contemplated in the several charters of the institutions hereby united."

In accordance with this law the University maintains a Department of Art, with the four years' course common to the higher classical colleges, and a Department of Applied Science, organized in accordance with the provisions of the United States Law of 1862,—also, with a four years' course.—There is, in addition, a "Literary Scientific" course, differing from the regular classical course only in the substitution of certain scientific studies in place of the study of the Greek language.

All the courses in both departments are open to young women, on the same conditions as to young men.

A Medical School is also attached to the University. An account of the Park Gallery of Art, attached to the University, will be found among those of the Art collections of the country, to be given in a later volume of this Report.

The Department of Applied Science presents the following courses:

A course in Civil Engineering.

A course in Theoretical and Applied Chemistry.

A course in Agriculture and Related Branches.

A course in Metallurgy and Mining Engineering.

The studies of Freshman year are common to all the courses. In Drawing—"Geometrical," is taught the first term; "Elementary Projection," the second; "Church's Descriptive Geometry," the third.

In the course in Engineering, Drawing is pursued through the four years. Sophomore year, the first term, "Descriptive Geometry; Plotting."

Sophomore year, 2nd term, "Shades and Shadows; Isometrical Drawing."

Sophomore year, 3rd term, "Shading and Tinting;" "Topographical Drawing."

Junior year, 1st term, "Linear Perspective;" 2nd term, Plotting Surveys of previous term; Construction of Maps;" 3rd term, "Structural."

Senior year: 1st term, "Mahan's Stone Cutting;" 2nd term, "Graphical Statics."

In the Agricultural Course, Drawing is taught, the 1st term of Sophomore year as "Descriptive Geometry completed;" it does not appear in the schedule of subsequent terms, nor at all, in either of the other courses of study.

In the Biennial Report of the Trustees, for 1879–'80 occur the following statements in regard to the courses of the Department of Applied Science.

The courses in agriculture, chemistry, civil engineering and mining, are designed to introduce young men into these professions through a training in the general and special sciences which relate to them. The industries of the world are no longer mere handicrafts. Every industry has a scientific basis, a thorough understanding of which is greatly helpful to success and essential to inventive improvement. The young men who are entering upon these professions are slow to appreciate these facts, but the educational institutions of the land must recognize and proclaim them till they are universally accepted. An eminent civil engineer says: "Scientific training is indispensable to any considerable success. Those who with out such preparation, engage as chain-men or axe-men in an engineer corps, expecting to work their way up, will be bitterly disappointed. Science and practice are both indispensable to an accomplished engineer. The latter he can get 'in the field.' The former can be obtained only at the schools." It is the same with agriculture, mining, pharmacy, dyeing, &c. Each of these industries is encircled by a group of sciences waiting to be auxiliary to it, if their help is invoked and will be received.

The various scientific courses, agricultural, chemical, mining, engineering, are designed to furnish this kind of instruction to those who are looking forward to one of these industries.

The catalogue for 1880–'81, shows a total attendance of 76 students in the undergraduate departments. There were, in addition, 143 Medical students.

LATER HISTORY.

The latest Catalogue at hand, that for 1892–'93,* shows, in the following statement, that the University has kept pace with the developments of Science; which continually makes new demands upon Educational Training. The schools of "Sanitary Engineering," "Electrical Engineering," and "Mechanical Engineering," demonstrate the progress, since 1880, in the needs of Institutions which undertake to fit students for the Scientific Professions.

Instruction is given in the University, in:

I. The Department of Arts, which embraces: 1. The usual Classical Course in the Languages, ancient and modern, Mathematics, Physical Science, Mental, Moral and Political Philosophy, Rhetoric, Literature and History, and leads to the degree of Bachelor of Arts; 2. The Literary-Scientific course, in which the studies of the Classical course are pursued with the exception of Greek, and which leads to the degree of Bachelor of Philosophy.

II. The Scientific Departments, embracing the studies required (1.) by the Morrill Act of 1862, which provides that instruction be given not only in "classical and other scientific studies," but especially in "branches of learning relating to Agriculture, and the Mechanic Arts;" and (2.) by the Endowment Act of 1890, which provides for instruction in "Agriculture, the Mechanic Arts, the English language, and the various branches of mathematical, physical, natural and economic science, with special reference to their applications in the industries of life."

These Departments, are:

1. The Department of Engineering, which includes (a) Civil and Sanitary Engineering; (b) Electrical Engineering; (c) Mechanical Engineering.
2. Chemistry.
3. Agriculture.

The degree in each case is Bachelor of Science, see index, *degrees*.

III. The Department of Medicine, leading to the degree of Doctor of Medicine.

The University has been enriched by the gift of the choice library of the late Hon. George P. Marsh, LL. D., an honored son of Vermont, formerly U. S. Minister to Italy, a scholar and author of world wide recognition. This library of between twelve and thirteen thousand volumes is especially rich in Philology, History and Physical Geography. Hon. Frederick Billings, of Woodstock, Vermont, purchased and presented this library to the University, and added to his gift that of a Library building, thus described in the catalogue:

The beautiful and commodious Billings Library, erected at a cost exceeding $150,000, with a shelving capacity of 100,000 volumes, contains the general library of the University and the special collections. The apse, originally designed for the Marsh collection, has been appropriated to the use of the reference library and reading room.

The gift of $10,000 which Mr. Billings made for the increase of the Library, is now being expended, and several thousand volumes have already been added.

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* Catalogue of the University of Vermont and State Agricultural College, Burlington, Vermont, 1892–93. Burlington Free Press Association Printers and Binders 1892. Pp. 113.

There is, also, a Museum building with large mineralogical collections; and other collections of natural history, archeology, and coins.

In the Engineering courses, drawing enters as an essential part in the course. In Agriculture there is no evidence that it is taught, nor does the catalogue show any courses in drawing other than "Mechanical."

The development of Manual Training, to an account of which the previous volume of this Report was so largely given, has record here in the new buildings adapted to instruction in Mechanics.

THE MECHANICAL BUILDINGS.

The University has recently completed the construction of a group of buildings suitable for the lecture rooms and workshops required for giving instruction in both Mechanical and Electrical Engineering.

The buildings consist of a *machine and carpenter shop*, a *foundry and forge shop*, and a building for *recitation and lecture rooms*. The latter building is of brick, sixty feet long and thirty-five feet wide, three stories high with a high and well-lighted basement, and contains six recitation rooms.

The foundry and the forge shop is another brick building forty-four feet long by thirty-two feet wide. The foundry is supplied with a cupola furnace, brass furnace, core oven and facilities for moulding. The forge shop contains eight forges, anvils, a hand drill and the hand tools necessary for instruction in this branch.

The machine and carpenter shop is a building seventy feet long by thirty wide, two stories in height. The upper story is used for the carpenter shop and is supplied with carpenter benches, a full line of tools for manual work, six wood turning lathes, an eight-inch pattern-maker's lathe, a circular saw and a scroll saw. A portion of this story is also used for the making of *blue prints*, or the reproduction of drawings. The machine shop in the lower story of this building contains three engines lathes, a hand lathe, a planer, a milling machine, two upright drills, a grindstone, emery wheels and filing and chipping benches. The lower story contains a Harris-Corliss engine of twenty-five horse power, a dynamo specially designed and provided with extra armatures and field coils and used both for purposes of instruction and to generate electricity for lighting the Engineering buildings, and for testing lamps, motors, etc.

The basement of the recitation building contains a general testing machine of 50,000 lbs. capacity, manufactured by Riehlé Brothers of Philadelphia and fitted for tensile, compression, or transverse tests, with an electric micrometer, for measuring elongation. It also contains a cement tester of 2,000 lbs. capacity, an electrical storage battery of sixty cells, and other apparatus used in these departments. The buildings adjoin and communicate conveniently with one another.

A full agricultural course is given. The students in agriculture are required to take a full course of shop work in wood and iron; and to attend lectures and recitations on "the elements of mechanism."

The military instruction and training required by the Land Grant Law, is given under the direction of an Army officer, detailed for that purpose by the U. S. War Department.

Tuition is sixty dollars a year; the total of College Bills is given from $91.50 to $113.00, according to room accommodation. All neces-

sary expenses of College Bills and board, washing, etc., range from $204.00, to $272.50. Attendance of students is given as follows:

Summary of Students.

Seniors,	44	
Juniors,	55	
Sophomores,	53	
Freshmen,	69	
		221
Students in Dairy School,		37
Students in Medical College,		190
Total,		448

The Faculty of the Department of Engineering number fourteen, in addition to the President of the University. The Teaching Force of the University, not counting the Medical Faculty, numbers fifty-one, in addition to the President. There are, in addition, ten special professors in the Medical Department.

Matthew Henry Buckham, D. D., President.

VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE, BLACKSBURG, VA.

The General Assembly, by act approved March 19th, 1872, gave one third of the land script allotted to Virginia, under the United States Grant of 1862, to the Hampton Normal and Agricultural School; and set apart the remaining two thirds, for the founding of a new institution to be called the Virginia Agricultural and Mechanical College, to be located at Blacksburg, Montgomery County; provided the real estate belonging to the Preston and Olin Institute, should be transferred to it, and that the county should appropriate $20,000 as an addition to its funds.

These conditions were complied with and the new institution was opened October 1st, 1872, with an attendance of 131 students.

The real estate of the "Institute," consisted of five acres of land on which was a three story college building, of 100 by 40 feet.

An additional estate of some 250 acres, but a quarter of a mile distant, was purchased for the farm of the new institution.

The committee appointed to report upon a plan for the organization of the proposed institution made, through its chairman Hon. Wm. H. Ruffner, State Superintendent of Education, an admirable statement of the Polytechnic and Agricultural training institutions in Europe, quoting at some length from the excellent and well known report on Education in Europe and the United States, made by Hon. John W. Hoyt, LL. D.*—The conclusions reached were that the new

* Paris Universal Exposition, 1867. Reports of the United States Commissioners. Report on Education, by John W. Hoyt, United States Commissioner, Washington, Government Printing Office, 1870. Pp. 398.

These Reports by the Government Commissioners were issued in six large volumes. Published by authority of the Senate, under direction of the Secretary of State, and Edited by William P. Blake, Commissioner of the State of California. Dr. Hoyt's Report, is the last of the five reports contained in Volume VI.—I. E. C.

Institution should be practical, and should not trench upon the ground already occupied by University, or College; but should seek to train practical agriculturists and mechanics.

A schedule of a three years course was recommended, the first years studies to be common to both the Agricultural and Mechanical courses. In both courses Drawing, "Free hand" and "Mechanical," holds an important place and is continued through the entire course.

The report closes with an appeal for additional and continued State aid, as follows:

We have this tremendous argument to back our appeal for an increase of endowment, viz: that this is the first thing the State has ever done in the way of collegiate education for the masses of her people, and even this is but the turning over of a gift from the Federal government. To neglect the special wants of the great producing classes is not only unjust, but exceedingly unwise. It is toward them the vitalizing power of technical education should be most studiously directed, and the forms of education should be so varied that its forces will take effect throughout the entire mass.

The Land-Grant was a recognition by Congress of the claim of the producing classes for forms of scientific education really suited to their wants, and the action of the Legislature of Virginia in creating a separate college was a similar recognition. This action of our Legislature was as wise in policy as it was just in principle, and may be regarded as an indication of the intention of that body to provide whatever may be necessary for its support. We cannot suppose that our industrial classes will be left wholly dependent upon the bounty of Congress for the means of technical education. Day laborers being left out of view, farmers and mechanics constitute the great bulk of our population. There are in Virginia, by the census of 1870, 73,000 farms, which no doubt represent at least that number of farmers (including proprietors and tenants). We have not yet been able to ascertain the number of mechanics in the State, but supposing it to be one-third less than the numbers of farmers, we have something like 125,000 white farmers and mechanics in the State, which is within 25,000 of the whole number of white registered voters in 1869.

These facts compared with our educational statistics show where lies the great field for technical education, and furnish a guaranty for the ultimate success of the Virginia Agricultural and Mechanical College.

The Legislature subsequently made appropriations running through several years, for additional buildings.

In 1880, Mr. Ruffner, at the request of the Board of Visitors of this College, undertook a tour of observation among the industrial colleges of the country, extending his visit to Canada. His Report, a a pamphlet of 39 pages, in which he also embodies a brief account of such other of the land grant colleges as he did not personally visit, is full of interest. A few paragraphs from his concluding remarks are here given:

Having thus completed such review as time allows, of the systems of education practiced in American Agricultural and Mechanical Colleges, I will close with some brief remarks founded on the facts observed.

I. As heretofore intimated, there is exhibited surprising contrariety of sentiment in respect to the meaning of the act of Congress of 1862, under which these institutions are largely supported. Some colleges aim to provide liberally all the educa-

tional facilities either required or hinted at in the act of Congress. Others feel at liberty to go just so far in supplying facilities as the means will pay for, and no farther. * * *

At the bottom of all these variations lies a question which has never been squarely met as it should have been—namely, whether the leading aim of these colleges should be to benefit the industrial classes personally or to benefit them technically; that is, whether the industrial classes are to be benefitted generally, in and for themselves as persons, or benefitted by increasing their intelligence and skill in their industries. For example, shall a technical college aim to provide general education for the sons of farmers and mechanics which will simply increase their general ability, or special education whereby those who are looking forward to the farm or the shop may be taught and trained in and for their respective occupations.

TO PROVIDE TECHINICAL TRAINING WAS THE EVIDENT INTENT OF CONGRESS.

The doubt that seems to exist in reference to this point has checked the harmonious development of the technical idea in education. The former interpretations cannot be maintained, because if the technical idea be thrown out, the whole proceeding of Congress in creating these colleges becomes irrational, and the colleges themselves can offer no good reason to the public why they should exist at all; for as respects the common branches of study, farmers and mechanics want no provision different from what is made for other people. Congress meant to promote the public interest by doing something for the industrial classes that would be equivalent to what has been done for the professional classes in other vocations.

And those who have studied the history of the technical idea all over the world, must observe the specializing tendency of education everywhere; that is, the tendency to have special courses for special things, and to weave liberal studies into these courses, less or more, according as these studies may or may not contribute to the practical result aimed at. A course of study must do the thing aimed at, or, whatever be its general merits, it is a failure. * * *

It is very certain that the thing demanded by the public of the technical college is the technical feature. This is what they look for, and talk about, and criticise. There must be something to show that this school is not a sham, but a reality true to its name.

SPECIAL DEVELOPMENT ACCORDS WITH LOCAL ENVIRONMENT.

The problem as to just how the end can best be reached, is one which has to be studied and decided by each State for itself. There will be certain cardinal points which should be the same in all, but there are other points on which each college should pursue a course adapted to its peculiar conditions. For example, it does not necessarily follow that because compulsory manual labor for three hours every day is a successful college feature in Canada or Michigan, that it would be successful in Virginia. The theory is right that to every technical course there should be a '*practicum*,' as some now term manual exercises,—and theoretically there is a certain right proportion between exposition and actual practice—but all theories in education as in other things should be modified according to the materials to be operated on. Whilst much may be done to educate public sentiment, true wisdom dictates that nothing should be attempted in education to which the public cannot be induced to respond promptly. Colleges must work among the people, not above them. The people must understand the college, and love it, and be proud of it—and thus only can you have a prosperous and useful college.

The catalogue for the session of 1880–81, shows that the institution is well equipped with buildings and with "shops which are provided

with a good steam engine, and with several excellent machines." There is a preparatory department of one year, and a course of three years; in each of the years of the college courses drawing is taught.

VI. Mechanics and Drawing.

Professor Blackford.

There are three classes in Drawing—the Junior, Intermediate and Senior. No rigid order of subjects is imposed, but all through regard is had to the taste, aptitude and prospective wants of the student. The course includes Topographical, Pen and Ink, Pencil, Water-Color, Architectural and Mechanical Drawing. A course of Descriptive Geometry belongs to the Intermediate Year.

The Senior class in Mechanics studies the theory of mechanics, as illustrated in modern machinery, engineering and construction.

The College Shops are under the control of the Professor of Mechanics. As means may be afforded, they will be put into steady and vigorous operation—affording to Students the opportunity of gaining skill in the use of tools and machinery.

The catalogue shows a total attendance of 78 students for the year 1880–'81.

The College in 1893.

The article by the President, from which the following extracts are taken, is a full and authoritative showing of the present prosperous development of the college. The article closes with a statement of the further needs of the college in the way of additional buildings and equipment, to enable it to receive all who now seek admission, in numbers largely in excess of present accommodations. These statements are here omitted. It will be observed that the course has been lengthened by a year, it being now the usual college course of four years; and that the facilities for Engineering and Mechanical training have been multiplied. The practical feature of supplying electrical light to the Village of Blacksburg is certainly an interesting "object lesson," illustrating the economic character of the education here given; the electrical light plant having thus nearly paid for itself within the first year. From this statement by the President, and from the details of the several courses as given in the latest catalogue, the practical quality of the thorough training here given in Agriculture, and in Mechanics, is very apparant.

The Outlook at the Virginia Agricultural and Mechanical College.

By Dr. J. M. McBryde.

[Reprinted from The Southern Planter, October, 1893.]

As you know, I have been promising to give to the farmers of Virginia, through the medium of your excellent journal, a short account of the present organization and condition of our Agricultural and Mechanical College—an institution which was established largely for the advancement of their interests and which depends in great part upon their patronage and support. I have deferred submitting such account until I could write with some assurance as to the results of the late re-organization of the College. I shall endeavor to be as brief as the nature of the subject will permit.

Reorganization.—The College was thoroughly re-organized by action of the Board of Visitors in July, 1891, by the election of a President, the appointment of several new professors, and the adoption of new courses of study.

The object arrived at in the reorganization was to make the College a real school of Applied Science—an Institution of Technology that will, in due time, be an honor to the State. Such instructors and equipments were, therefore, provided as would give thorough theoretical and practical instruction in the courses underlying Agriculture and Mechanics and other culturists, civil, mechanical and electrical engineers and analytical chemists, and, in time, mining engineers, architects, viticulturists, veterinarians, etc. At the same time, it was recognized that the students were not only to be trained as specialists, but also to be educated for the duties of citizenship. Provision was, therefore, made for instruction in English, Political Economy, Constitutional History, and Ethics.

In order to give practical effect to these views, the following positions were established: Professorships of Mathematics and Civil Engineering, Mechanical Engineering, Horticulture (including also Entomology and Mycology), English (including History and Political Economy), Biology, Military Science and Tactics.

Adjunct Professorships of Modern Languages, Physics, and Electrical Engineering, General Chemistry (including also Geology and Mineralogy), Agriculture, Analytical Chemistry, and Veterinary Medicine.

Assistant Professorship of Mathematics.

Instructorships in Machine Work, Wood Work, and Book-keeping.

In the establishment of a regular gradation in the teaching force, the value of the principle of promotion, with increase of salary for faithful service, was clearly recognized. It was sought to make the stimulus, inherent in this principle, bear upon the younger teachers.

COURSES OF STUDY AND METHODS OF INSTRUCTION.

The scheme of study and methods of teaching adopted may be succinctly set forth as follows:

The Sciences, especially those related to Agriculture and the Mechanic Arts, hold, in strict accordance with the Acts of Congress from which the College derives its income, the foremost place. Large provision is made for instruction in their principles and applications to the industries of life.

In order to meet the wants of different classes of students, nine distinct courses of study are offered—seven courses, of four years each, leading to the degree of Bachelor of Science, and two courses, of two years each, for certificates. All are grouped under the two general heads of *Agricultural* and *Mechanical*. Under the first head are included the degree courses of Agriculture, Horticulture, Applied Chemistry, and General Science, and the Shorter Course of Practical Agriculture; under the second, the degree course of Civil Engineering, Mechanical Engineering, and Electrical Engineering, and the Shorter Course of Practical Mechanics.

The first, or freshman, years of all the courses are very nearly the same, and include the fundamental studies—Mathematics, History, English, and Inorganic Chemistry, as well as Physiology and Book-keeping. The courses begin to diverge in the Sophomore year, and the differentiation is complete in the Junior year.

Every course contains a certain element of general or liberal culture in addition to the special or technical studies appropriate to it, the aim being to give the students a practical as well as theoretical knowledge of the sciences related to the profession or pursuit he proposes to follow, and, at the same time, to fit him intelligently to discharge the duties of citizenship. To this end he is made to study the Constitutional History of his country and the general questions affecting its material interests, and is taught the correct and ready use of his mother tongue. The general or

liberal studies required in every degree course are Mathematics, English, French, German, General and Constitutional History, Physiology, Political Economy and Ethics.

A course of preparatory or sub-collegiate study, covering one year, is arranged for applicants unable to meet the requirements for admission to the Freshman Class.

PRACTICAL WORK REQUIRED IN EACH COURSE.

The method of instruction adopted combines theory with practice. Laboratory or practical work is required in every department. In English and Modern Languages compositions and other written exercises are exacted; in Physics, Chemistry, Mineralogy, Mycology, Botany, Zoology and Physiology, laboratory work; in the different branches of Engineering, shop or field work and mechanical drawing; in Agriculture and Horticulture, shop and field work; in Veterinary Medicine, dissecting and clinics. Such practical work is intended to illustrate, emphasize and apply the principles and theories propounded in the lecture-room.

The drills and other military exercises required in every course, in connection with the shop and field work, develop the bodily powers of the student and greatly contribute to his physical well-being.

The courses of study are so arranged as to give the student sixteen hours of class work or recitation and fifteen hours of laboratory, shop or field work a week. The lecture or recitation continues one hour; the exercises or work in the laboratory, shop or field three hours.

All required work in the shop or field is held to be instructive and is not paid for. The College provides, as far as its means permit, uninstructive work or manual labor for the students needing pecuniary assistance. Such work is paid for at rates proportioned to the value of the labor performed. By our schedule of lectures a student has at his own disposal about fifteen hours a week, which he can, if he chooses, devote to such labor. It is possible for an industrious student to earn from $2 to $4 a month, or $25 to $40 during the session.

NECESSARY EXPENSES.

The cost of the session is estimated as follows:

Tuition fee	$30.00
Matriculation fee (payable only once)	5.00
Infirmary fee (covering medical attendance, etc.)	5.00
Contingent fee (deposit to cover damages and balance returnable at end of session)	5.00
Steam heating	9.00
Electric lights	2.70
Janitor's fee	2.25
Board at $9 per month—nine months	81.00
Washing at $1 per month—nine months	9.00
Uniform	16.75
Text-books	10.00
	$175.70

Provision is made by Statute for the free education at the College of 200 young men from the State. The act reads as follows:

"A number of students, double the number of members of the House of Delegates, making two hundred, shall have the privilege of attending said College free of tuition, to be selected by the school trustees of the respective counties, cities, and election districts for said delegates, with reference to the highest proficiency and

good character, from free schools of their counties, or, in their discretion, from others than those attending said free schools."

The cost of the entire session of nine months to holders of State Scholarships is, by this provision, reduced to $145.70.

AID OFFERED TO NEEDY STUDENTS.

The College, in addition to this provision, endeavors to assist young men of limited means in their efforts to secure a collegiate training. Such young men are fully alive to the importance of application and study, and disposed to improve to the utmost the advantages offered them here. To give effect to this aim, all paid employés have been, as far as possible, dispensed with and their work divided among needy students. In this way we are enabled to give remunerative work to nearly fifty young men. The amounts paid them range from $5 to $20 per month. Some run our engines and dynamos; some fire our furnaces and boilers; some sweep out the shops and clean the machinery; some make brooms, others milk; a number are employed in our several departments making out and collecting bills for milk and vegetables sold, for electric lighting and work done for outsiders in our shops, directing and mailing our Station bulletins (14,000 copies of each monthly bulletin are issued), and quite a number will hereafter wait at our tables in the mess. The young men engaged in such laudable efforts to work their way through college generally have excellent records as students, and all are greatly respected by their fellow-students. They promise to make self-reliant, sturdy, and well-equipped men. The sentiment of the students in regard to manual labor is admirable. The demand for work of any kind that will aid them to pay their way in part through College—no matter how severe and exacting it may be—is far beyond our power to meet.

And in addition to this demand for work from our own students, hundreds of letters come to us from young men all over the State pressing upon us their desire to avail themselves of the advantages offered them here, frankly pleading their poverty, but affirming their willingness, nay, eagerness, to accept any work that will aid them in meeting their collegiate expenses. A labor fund, which, in a large number of States, is annually given by their legislatures to Colleges like ours, would enable us to meet this demand, and to train for success, in industrial pursuits a large number of bright and promising youths who are now cut off by their poverty from all hope of advancement in life. The sums allowed in other States generally range from $5,000 to $10,000 a year. The smallest amount, $5,000, would enable us to aid from 50 to 100 young men in partly working their way through College, and at the same time, by means of their labor, to improve our farm, gardens and orchard, add to our buildings and other equipments, and greatly beautify our grounds. It is not our intention to establish beneficiary positions. Every young man is all the better and more independent for helping himself to the best of his ability.

RECENT ADDITIONS TO BUILDINGS AND EQUIPMENT.

Among the many improvements effected since the reorganization of 1891 may be briefly mentioned the following:

Veterinary Infirmary, a wooden building of nine rooms, supplied with steam, water, and gas. Forge and Foundry, one-story brick building, erected and partially equipped with the appropriation of $3,750, allowed us by last General Assembly. The body is 110 feet by 30 feet, with an L 60 feet by 30 feet, and a second L 25 feet by 30 feet. The Forge shop is supplied with 6 forges, a blower, and the necessary blacksmith's tools; the foundry, with a cupola. Two thousand dollars additional will be required fully to equip the forge and foundry.

A combined creamery and cheese factory is nearly completed—erected out of proceeds of farm produce. From this same source we have been able to supply the farm with additional silos, stabling, and laborer's cottages.

A convenient house has been rented and fitted up as an infirmary. The ward is well lighted, and contains 12 beds. It is under the immediate charge of a competent matron.

An old building, called the Pavilion, and used for Commencement exercises, has been fitted up for a Mess Hall.

The wooden building, formerly used for shops, has been fitted up for a Steam Laundry. A party, not connected with the College, has put in, at his own risk, an excellent steam laundry plant, the College merely guaranteeing to him the washing of the students.

A small brick magazine has been erected for the storage of ammunition, and a neat wooden building over our reservoir.

The floors of the basement rooms in the two academic buildings have been lowered, and the rooms formerly used for cellars, coal-bins, etc., have been converted into excellent lecture-rooms and laboratories.

A large 5,000-gallon tank has been put in the tower of the Dormitory building. By this arrangement, a good head of water is furnished to all our laboratories; and in case of fire, a stream of water can be thrown on the roofs of all the buildings on College Hill. With our reservoir of 14,000 gallons, and two tanks of 6,000 gallons, we are enabled to keep a large reserve supply of water. Our supply comes from an excellent spring.

ELECTRICAL LIGHTING ENTERPRISE.

Our system of electric lights has been extended into the village of Blacksburg. The income derived from the extension has been nearly sufficient to cover its cost within the year.

The more important additions to our equipment may be summarized as follows: The partial equipment of the new Forge and Foundry has been referred to above.

All the lecture-rooms, offices and laboratories have been supplied with new seats, tables, desks and cases, and the dormitories and infirmary with new furniture, made by our own students in the shops.

One hundred and fifty new Springfield rifles and two pieces of artillery, together with the necessary belts, bayonets, etc., were secured last spring from the General Government.

A laboratory has been fitted up for assaying, in order to carry on the work in this line ordered by the last General Assembly. The Act imposed upon the Board of Agriculture the duty of assaying any minerals sent in for examination by any land-owner in the State. Under an arrangement made with the Board of Agriculture, several hundred assays have been made by our chemist during the last year.

An electric clock, designed and made entirely in our shops, has been put in and connected by wires with every College and Station building. We now have uniform time in every department of the College.

Large additions of live stock, including Holstein and Guernsey cattle, and Berkshire, Poland-China, and Essex swine, have been purchased for the farm, and some fifteen *grade* cows added to the dairy herd, which supplies all the milk consumed in the College Mess.

The farm has also arranged to supply the Mess with meat.

Chemical, physical, biological, mycological, and bacteriological laboratories have been fitted up and supplied with the necessary apparatus.

THE EQUIPMENT AND FACILITIES OF THE COLLEGE.

As at present equipped for its important and expensive work—for all scientific and technical work is necessarily expensive—the College has buildings and lands as follows: Campus of about thirty-five acres of land; a farm of about three hundred acres; two large academic buildings, of three stories each, containing library, reading room, two society halls, ten lecture rooms, physical laboratory, botanical laboratory, chemical laboratory (four rooms), assay laboratory (four rooms), and four offices; dormitory building containing seventy-two rooms; horticultural building containing lecture room, mycological laboratory, and five office rooms, with adjacent greenhouse, boiler room and vegetable storeroom; veterinary infirmary, with lecture room, bacteriological laboratory, museum, dissecting room, operating room, drug room and offices; creamery and cheese factory; mechanical building containing wood shop, machine shop, engine room, storeroom, lavatory, boiler room, and office; forge and foundry building, containing forge room, foundry, and large office; steam laundry, with twelve students' rooms on second floor; five professors' houses; six laborers' cottages; stables, silos, etc.; orchards, vineyards, and gardens.

The Station has carried on many lines of experimental research. The results already reached have been given to the public in the bulletins:

* * * * * * *

Fourteen thousand copies of each bulletin are printed and distributed among the farmers of the State. We hold ourselves prepared to furnish our publications to any farmer of the State making written application for them.

One hundred and sixteen students were enrolled during the session of 1891–92; 177 during the session of 1892–93—an increase of 61. From the number of letters received, there is every promise that we shall have from 225 to 250 students next session (1893–94).

The President under date of March 22nd, 1894, announces the enrolment of 236 students in attendance.

* * * * * * *

The appeal for increased State support is thus introduced:

The needs of the College are many and pressing. Its buildings are insufficient to accommodate the rapidly-increasing number of students.

* * * * * * *

The special attention of his readers was called by the editor of "The Southern Planter," to the article from which the above extracts are taken; and the plea of the President for additional aid from the State, heartily endorsed.

The latest catalogue,* is illustrated with views of the buildings and of the interior of the woodworking shop. There is no course in Drawing other than in the Mechanical Drawing essential to the several courses in Engineering, and to the Course in Mechanics. In these courses drawing is taught through the four years; each class meeting twice a week, and giving a session of three hours to their drawing.

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* Catalogue of the Virginia Agricultural and Mechanical College, 1892–'93, Blacksburg, Virginia. Richmond, Va.: Everett Waddy Co. Publishers and Printers, 1893. Ill. Pp. 80.

In the Department of Shop Work, there are eight classes. A director, and three assistants, have charge of this department. The details given of the courses in Mechanical Engineering, Electrical Engineering, and in Shop Work, show that the standard of training in these studies is in accord with the demands of modern scientific and industrial education. The following details given in the catalogue show the existing facilities for shop work.

DEPARTMENT OF SHOP WORK.

Director Anderson. Instructors Cunningham, Bray and Porcher.

* * * * * * *

Equipment.—The main building is 40 by 110 feet, two stories high: The machine shop, the supply room and the engine room are on the first floor; the wood-working room is on the second floor, and the store rooms for lumber in the attic. The wash room is between the two floors. Power is furnished by a fifty-horse power Buckeye engine, which also drives the electric light dynamo. This is connected to the main head shaft by a friction clutch, so that the shafting of the shops can be started or stopped at pleasure without interfering with the engine. The shafting of each room is also connected with its head shaft by a clutch.

During last summer a very substantial one-story brick building was erected for use as a Foundry and Forge Shop. The body of the building is 110 feet by 30 feet. At one end there is an L 60 feet by 30 feet and at the other an L 25 feet by 30 feet. The forge shop occupies the 60 feet by 30 feet L and is now partially equipped and in operation.

The foundry is not yet equipped, but is expected to be in running order by the opening of next session. The boiler and coal house is a brick building 22 x 45 feet detached from the other buildings.

Steam is generated by a battery of two sixty-horse power horizontal return tubular boilers, fitted with all modern appliances. One supplies sufficient steam for our needs and the other is kept in reserve. The shops throughout are heated by exhaust steam from the engine and lighted by incandescent lights.

The Wood-working room is 40 x 110 feet, and contains eighteen work-benches (described below); twelve 12″ x 5′ turning-lathes (described below); one large turning lathe, one combination rip and cut-off circular saw, one large circular saw, one hand-saw, one scroll-saw, one mortising and boring machine, a reversible shaper, one double-headed universal wood-worker, one 24″ surface planer with tongue and grooving attachment, one Daniel's planer, one steam glue heater and one steaming-box. The work-benches are 8 x 2½ feet, strongly and neatly built of oak. Below are two closets, and at the back of the top are two tool-cases, each case containing the following tools: One rip-saw, one panel-saw, one tenon-saw, one joint-plane, one jack-plane, one smoothing-plane, one block-plane, one claw-hammer, one mallet, one set of chisels, one set of gouges, one screw driver, one scriber, one framing-square, one try-square, one bevel-square, one marking and mortise-gauge, one pair of compasses, one bit-brace, one set bits, one brad-awl, one oil-stone, one oil-can, one rule and one dust-brush. Each bench is fitted with a Massey's vise; one bench accommodates two students working on alternate days, each student having exclusive use of one set of tools and one closet. The turning lathes are equipped similarly to the benches, each lathe having two sets of tools. Each set is arranged on a system of boards, and kept when not in use in cases under the lathe; when used these boards are placed on the rear end of the lathe, where the tools can be easily reached by the student at work. A set of lathe tools includes three turning gouges, three turning chisels, one parting tool, one pair of calipers,

one pair of dividers, one hammer, one oil-stone, one slip-stone, one oil-can, and one dust-brush. As with the benches, each lathe accommodates two students on alternate days, each student having a set of tools and a case to himself. Sixteen feet is cut off at one end of this room; a part of this space is used as the instructor's office. Among other things kept in this office is a complete set of tools not in such frequent demand as to necessitate their being included in the regular sets. The remaining part of the space is made dust proof, and used as a finishing room.

The Forge Shop now contains six improved cast-iron forges, with water and coal boxes and adjustable hoods; six 180-pounds Peter Wright anvils; six complete sets of forge tools, each consisting of four pairs of tongs, one sledge, one flatter, one set-hammer, one cold chisel, one hot chisel, one hardy, two punches, two pairs of fullers, two pairs of swages, one shovel and two pokers; twelve sets of hand-tools, each consisting of one hand-hammer, one prick punch, one 12″ square, one pair of calipers, one pair of dividers; two benches fitted with three vises, and having below eighteen locked cupboards in which the students keep their hand-tools and unfinished work. In one corner of the forge shop is an 8 x 8 feet office for the instructor, in which is kept a complete set of fullers, swages, punches, headers and other tools for general use. A 35″ Buffalo blower furnishes blast for the forges.

The Machine Shop occupies a space 80 x 40 feet, and contains eleven work-benches (described below), one 14″ x 6′ Flather engine lathe with taper attachment, two 14″ x 6′ Flather engine lathes, three 17″ x 5′ Muller engine lathes, one 16″ x 8′ Reed engine lathe, one 10″ x 5′ Reed engine lathe, one 12″ x 4′ Diamond hand lathe, one 10″ speed lathe, one 15″ Walcott shaper, one 10″ x 10″ x 22″ Hendy planer, one 24″ x 24″ x 5′ Gray planer, one No. 15 Brainard universal milling machine, one 18″ Reed drill press, one emery grinding machine, one grinding stone, one pipe vise and bench with tools for working pipe up to 3″. In the instructor's office are kept for general use in the shop complete sets up to one inch of twist drills and taps and dies, up to two inches of reamers and mandrils; an assortment of files of various sizes and shapes, of calipers, scales, squares, hammers, chisels, and many other tools. The work-benches are on the same plan as those of the wood-room. They are eight feet long and two and a half feet wide, and have a four and a half inch swivel jaw machinist's vise on each end; in the centre of rear edge are four cases of tools (two for each vise) and below are four closets. Each tool-case contains the following: One ball-pin hammer, two cold chisels, two cape chisels, one prick punch, six assorted files, one scraper, one 4″ scale, one 3″ machinists' square, one centre gauge, one scriber, one pair of 6″ outsider calipers, one pair of 5″ inside calipers, one pair 3″ outside spring calipers, one pair 5″ spring-dividers, one 10″ monkey-wrench, one screw-driver, one set of eight lathe cutting tools, one oil-stone, one oil-can, one file card, one pair of copper jaws for vise, and one dust-brush. Each bench will accommodate four students (two on alternate days), each student having a set of tools and a closet to himself. Each machine has a box under it, in which its attachments are kept, and a stool near it for the reception of tools when in use.

The Supply-Room, located in the main building, is 14 x 22 feet, and is fitted up with shelves, racks, cases, etc., for the storage of supplies. A dry-kiln for drying lumber is situated over the boiler-room and heated by steam.

The situation and surroundings of the college are thus described:

LOCATION.

The college is located in one of the most beautiful sections of Southwest Virginia, It immediately adjoins the town of Blacksburg, is about eight miles distant from the Norfolk and Western railroad, and one hundred miles west of Lynchburg. Its situation on the summit of the Alleghanies, some 2,100 feet above sea level, secures for it a delightful summer climate. Several of the most popular watering places in the State are only a few miles away. The winters are by no means severe.

The nearest railroad point is Christiansburg depot. There is a daily line of hacks between this depot and Blacksburg. The two places are also connected by a telephone line.

The summary of attendance for the year 1892–'93, is given in the catalogue as follows.

RECAPITULATION.

Graduate Students		10	
Under-Graduate Students:			
Seniors	6		
Juniors	12		
Sophomores	28		
Freshmen	54		
		100	
Special Students		50	
Total Collegiate Students			160
Sub-Freshmen Students			17
Total			177

The "Faculty and Officers" of the College, number twenty-seven. John M. McBryde, PH. D., LL. D., is the President.

HAMPTON NORMAL AND AGRICULTURAL INSTITUTE, HAMPTON, VIRGINIA.

This Institute, which has become one of the best known, as it is one of the most interesting, of the educational institutions in the country, was established in 1868, by the American Missionary Association of New York, with the purpose of aiding in the education of the colored people. It was opened in April 1868, with an attendance of fifteen scholars, on a manual labor basis. In 1870, it was chartered by the General Assembly of Virginia, a Corporation of 17 members being created under the corporate title of "The Trustees of the Hampton Normal and Agricultural Institute," empowered to elect their own successors. In March, 1872, the Legislature granted to it one third of Virginia's share in the United States Land Grant to Agricultural Colleges. The remaining part of the fund going, as already stated, to found the Agricultural College for whites at Blacksburg;

This sum was invested in State 6 per cent Bonds. The State annually pays the interest $10,000, to apply to the many expenses of the institution. The United States Freedman's Bureau, also made liberal grants by which needed buildings were erected. Benevolent individuals have also given land and funds for needed purposes, while many annual scholarships of $70 each, are endowed.

The Institute has taken a farm of 600 acres, and is building a machine shop, etc. The wise management and the enthusiasm of Col Armstrong, the principal of the school, having created a very general interest in his undertaking. It is largely due however, to the

experiment here inaugurated in April 1878, of training Indian youth, that especial interest has been awakened in the work of the Hampton Institute. The two races have been taught together and so far the experiment has met with great success.

Speaking of the Indians, the Principal in report of 1879, says:

The girls go to school five days each week, are taught sewing, household work, and are to be instructed in cooking and gardening.

The boys work on the farm, a few in shops, an entire day each week, and besides, are divided into squads so that each one works two hours daily for four days each week in the "training shop," under Mr. G. B. Starkweather, where they are taught the use of tools, and to work in wood, iron, tin and leather. Saturday is holiday, with free access to shops, where many resort voluntarily.

Our Indian youth are encouraged to practice and improve in their native art. Painting on paper, fans, and on pottery, brings them pocket money which keeps them cheerful.

The negro has the only American music; the Indian has the only American art. I believe it to be a duty to preserve, and in a wise and natural way to develop both. The latter is curiously suggestive of ancient Egyptian or oriental styles. There is an oriental expression in the Indian's countenance.

Our Indian paintings are much sought after, and are doing good in many places as reminders of the needs of a noble but wronged people.

In the Report of 1880, the Principal thus speaks of the progress, of the Indian pupils:

Their studies are rudimentary; teaching is chiefly by the object method. They are now reading simple stories, are eager to learn, and most interesting as pupils.

In work they are slow, but as a rule, willing, and have made satisfactory progress. In the Indian workshops the following articles have been made: a one-horse cart complete, and quantities of spokes and other materials used in wheel-wrighting; a variety of small and useful articles of blacksmith work; all the wooden tables used in the school, and many articles of woodwork; all the tinware needed by the school; most of the shoe-mending, and a few pairs of shoes. They have replaced broken window-panes, and done many small jobs in painting and other mechanical work. They have, under direction of a carpenter, built a two-story carriagehouse, 24 x 50 ft., weather-boarded and shingled.

The farm squad has worked regularly half a day, cultivating the various crops.

The girls have had instruction in household industries, washing, ironing, and cooking. They are learning to make and mend their own clothes.

Instead of receiving clothing as fast as it was worn out, the boys have been put on wages, out of which they are expected to purchase their clothing; there is some waste, but the consequences of any folly are sure to be felt, and a valuable lesson in the use of money is thus given. Putting men on a manly footing is the best way to promote manhood. This fact is at the bottom of any success with the weaker races of our country.

The government allows $150 per year, for each Indian pupil; this however, with the earnings of his labor, does not meet the cost; the deficiency is made up by gifts of individuals and societies.

The school differs from most of the other institutions that have arisen under, or are benefitted by, the United States Land Grant, in that it is really a manual labor school. "Labor is required of all for the sake of discipline and instruction." Day scholars are expected

to work at the rate of one hour a day without compensation, at such industries as may be assigned them. Students usually work during one school day each week and the whole or half of Saturday, thus securing four whole days for study each week, and from one and a half to two days of work."

EMPLOYMENTS TAUGHT.

"The following is a list of school industries:

The farm, with bone-grinding, grist-mill, soap-making, blacksmith's shop, butcher's shop, and milk-dairy.

The engineer's department, with knitting-machines, broom-shop, shop for iron-work, rag-carpets weaving, and carpenter-shop.

Girls' industrial department, for making and mending garments, and learning to sew by hand and machine.

Household work, including washing, ironing, table duty, and cooking lessons for the girls." * * * *

The problem of the school, industrially is—1st. To make labor as instructive as possible. 2nd. To turn it to the best account.

By giving each student one and a half or two days' work each week, and four whole days for study (by having a detail of one-fifth out of each school day, and all or one-half on Saturdays), his mental interests do not suffer materially; he is physically better off; is able to pay about one-half, in some cases the whole, of his personal expenses; is better fitted to take care of himself, and becomes more of a man.

Labor schools are expensive. We do not expect our industries, as a whole to pay. They are primarily educational; yet they have, under the circumstances, done well this year; and in time some of them will, I think, be remunerative; but that is not to the point.

In respect to its manual labor feature, the school has been considered an experiment.

A fair conclusion is this: If its friends are ready to pay the increased cost of giving a practical education, by training both hand and head, the work can be done here; and the student will be fitted for life far better than he would be without that drill.

In addition to the regular students there are so called work students, who pass their first year at work, for wages, all day through the whole year, and attend night classes.—"They earn enough, often, to carry them through all the rest of their course in the Institute, and get habits of industry and self help to last them their lifetime."

OF THE SCHOOL AND STUDENTS.

The course of study is three years. The first two include elementary studies of a wide range; the last, higher mathematics and some scientific instruction; enough, I think, for the purpose of the school, which is to develop character and educate teachers for the colored race. Political, natural, and moral science in the senior year test their powers, and are needed both for mental discipline and for their practical value. I need not dwell on the academic work of the Institute, although it is the leading department, to which all others are subsidiary. It requires the entire time of twenty teachers. It embraces the studies of a primary, grammar, and high-school course. No dead languages are taught. Our advanced work will more and more be scientific. In this direction almost nothing has been done for the colored

race. It will be of great use to them in the development of the resources of the country about them.

The standard of admission—a knowledge of reading and writing, and of arithmetic, through long division—cannot be raised till more thorough work shall be done in the public free schools. The crowds that irregularly attend them, as badly off for books as for clothing, make slow progress.

In the course of study of the first year, "Map drawing" is taught. Regular instruction in practical farming is begun with the boys and continued throughout the three years course, while like teaching in sewing and household industries is taught the girls.

Free-hand drawing is one of the regular studies of the second year, it is not given the last year.

An attendance of 211 colored boys and 160 colored girls, in all 371; and of 62 Indian boys and 28 Indian girls, in all 90; making a total of 461 students, is reported for 1881.

A total of 501 pupils, is reported for 1881–'82; of these there are 28 Indian girls and 61 Indian boys. In all, 89 Indian youth. Leaving a total of 412 colored students; of these 173 are girls, and 239 boys.

A NOBLE LIFE.

The death of General Armstrong, which took place on Thursday May 11th, 1893; a few days before the celebration of the twenty fifth anniversary of the founding of the Institute, to which his life had been so unreservedly devoted; lends a deeper interest to his latest words, contained in his twenty fifth annual report, for the year ending June 30th, 1893, which he had prepared for that occasion. Before this, in the book issued by the Institute, entitled, "The Records of Hampton's Twenty-Two Years' Work"* the principal had, for the first time, given a personal statement concerning his own life work. Some sixty pages of this book were issued in pamphlet form two years before the Volume. These bits of autobiography, and details of the origin and growth of the wonderful work which he initiated and accomplished; are, in themselves, so full of interest, and are so intimately related to the race problems of education which confront the American people, that no apology is needed for their introduction here. The experiments of industrial training undertaken at Hampton, are so directly in line with the topics treated in this volume of the present Report, and are of such vital importance to the future welfare of the African and Indian populations of these United States, that the methods there adopted are stated here at unusual length. The judgment of General Armstrong, as to the kinds of training best adapted

*Twenty-Two Years' Work of the Hampton Normal and Agricultural Institute, at Hampton, Virginia. Records of Negro and Indian Graduates and Ex Students, with historical and personal sketches and testimony on important race questions from within and without, to which are added, by courtesy of Messrs. Putnams & Sons, N. Y., some of the Songs of the Races gathered in the School. Illustrated with views and maps. Hampton Normal School Press. 1893. Pp. 520.

to the wise development of our African fellow citizens now numbering over eight millions, is entitled to the most serious consideration by blacks and whites alike. The daring experiment by him begun and carried out with such gratifying success, challenges the attention of all educators.

Of this heroic man, whose life ended at the comparatively early age of fifty four years, the Christian Union, in an appreciative memorial editorial in its issue of May 10th, 1893, says: "His whole life was a consecrated one. Hampton Institute is a nineteenth-century cathedral, built by a ninteenth-century saint, to the glory of God." To the two races so greatly wronged by the white race on this Continent, he gave, and inspired others to give, unstintingly.

His faith in the generous coöperation of the good people of America, knew no shadow of doubt, and his personal devotion to the welfare of those children of the darker races, left no opportunity for failure. In this so called "Age of Materialism;" Hampton Institute, stands in glorious protest against the aspersion, and furnishes striking evidence of the existence and efficacy of Christian self abnegation and sacrifice.

THE MEMORIAL SERVICE.

On the afternoon of the "Anniversary Day," Monday, May 25th, 1893, was held the memorial service to the Founder of the Institute. A great throng were in attendance. Distinguished Divines from the North, friends and Trustees of the Institute, paid eloquent tributes to the memory of the man. From the addresses made, two typical tributes, illustrating the wisdom, generous nature and greatness of this Great Teacher, are here quoted from the report of the memorial service in the New York Evangelist, of June 15th, 1893. The first is by a colored Teacher, trained at Hampton, who has himself successfully directed a similar school in the far South; Mr. Booker T. Washington, Principal of the Tuskegee Normal School, Alabama: the other is by an old Virginian, a resident of Hampton, who, as an ex-Confederate officer, might well have been prejudiced against this Union General, who came there as a special champion and guardian of the enfranchised negroes. To have developed in one of these despised contrabands such qualities as his address indicates; or to have overcome the natural prejudice of a Virginian and former slave owner, evidences both the integrity of character and the rare abilities of the Teacher, as well as the powerful personal influence of the man; which was so marked a characteristic of General Armstrong.

In addition to the income of the institution arising from the Land Grant Fund, the annual appropriation by the State Legislature, and the profits from the Farm, and Work Shops; General Armstrong was forced himself each year, to raise some sixty thousand dollars by personal appeals to the benevolence of private individuals through-

out the country. With a faith that never faltered he successfully accomplished his self-imposed task; and, possibly, by no surer method could the great work that was being wrought out at Hampton, have been so effectually brought to the knowledge of the American people. To successsully create, care for and direct in all their material and educational needs, a community of several hundred persons; and by his own exertions, to secure as a free gift each year, so large a sum of money by personal addresses and appeals to the community, argues the possession of extraordinary executive capacity and uncommon self devotion to duty.

Such was the life work of Samuel C. Armstrong, subsequent to his patriotic service in the Armies of the Union.* Of the man and of his influence over his pupils, his former scholar thus bore witness at the memorial meeting just referred to:

ADDRESS BY PRESIDENT WASHINGTON, OF TUSKEGEE.

It is comparatively easy to speak of the General as our teacher, but he was more. He was the heart of our race, and held us so strongly and tenderly there that the great heart broke when most men were just beginning to live. He was more than a friend; the power of his love, his confidence, his personality was so great that his students' reverence is almost worship. But the last thing he would want is words of praise; every spark of energy in him went to the purpose of lifting up the unfortunate. His work in Virginia you all know. The rose I place on his grave is *his* work at Tuskegee. Eleven years ago it began with thirty pupils and

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*I am indebted to President Frissell for a copy of the touching "Memoranda" written by General Armstrong and found after his death, deposited with his will. In these few words, from beyond the tomb as it were, the genuine simplicity, reverent devotion, and cheerful spirit of the man, appear. A few sentences from the opening and closing paragraphs, are here quoted. He wishes no biography, states the main incidents of his life, and is thankful for all the blessings he has recited; speaks tenderly of wife and children; and rejoices in his opportunities at Hampton, which "has blessed me in so many ways."—I. E. C.

The paper was written "to say things that I should wish known should I suddenly die. I wish to be buried in the school grave yard, among the students, where one of them would have been put had he died next. I wish no monument or fuss whatever over my grave; only a simple headstone—no text or sentiment inscribed, only my name and the date. I wish the simplest funeral service, without sermon or attempt at oratory—a soldier's funeral.

I hope there will be enough friends to see that the work of the School shall continue. Unless some shall make sacrifices for it, it cannot go on. A work that requires no sacrifice does not count for much in fulfilling God's plans. But what is commonly called sacrifice is the best, happiest use of one's self and one's resources—the best investment of time, strength, and means. He who makes no such sacrifice is most to be pitied. He is a heathen, because he knows nothing of God. * * * Prayer is the greatest power in the world. * * * Hampton must not go down. See to it, you who are true to the black and red children of the land, and to just ideas of education. The loyalty of my old soldiers, and of my students, has been an unspeakable comfort. It pays to follow one's best light—to put God and country first; ourselves afterwards. Taps has just sounded." "S. C. Armstrong."

"Hampton, Va., New Year's Eve, 1890."

one teacher; to-day it has six hundred students and thirty-four teachers, owns one thousand four hundred acres, twenty-eight buildings, of which seventeen were built by our students.

Our great chief taught us that all material success is nothing except as it contributes to the elevation of mankind. How has Tuskegee stood this test. Its white neighbors have become its friends, and respect General Armstrong and his work. Into the darkness around it, where a dense population of colored people live, in ignorance and abject poverty and degradation, Tuskegee teachers have gone and revolutionized different communities. General Armstrong saw that to raise men there must be training of head, heart, and hand. Four hundred Tuskegee students have received enough to go out and give it. They have taught 30,000 children in the Gulf States. Tuskegee has been instrumental in starting industrial schools at Calhoun and Mt. Meigs, and in starting the annual Tuskegee Conference of Farmers. At first General Armstrong's methods were opposed by many. Now they are seen to be right all through the South. There are still millions to reach. Let it be the ambition of Hampton's children to work as he worked, till we carry a drop of his life-blood to every darkest corner of the darkest South, and in doing so, we shall not forget to uphold the hands of him whom General Armstrong loved, and on whose shoulders his mantle has fallen." [Rev. H. B. Frissell, newly appointed Principal, to the satisfaction of all at Hampton].

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From the several eloquent, appreciative and touching addresses, illustrating as they did, the various phases of this strong man's character; showing his great heart full of sympathy for all the oppressed, his rare tact, discretion and executive force, the two tributes which, on the one hand, prove his power over his pupils, and on the other, his success in winning the friendship of a hostile, or, at least, an indifferent community, are chosen. The words of his former pupil have already been given. Later in the exercises his Hampton neighbor spoke, as follows:

ADDRESS BY COL. TABB.

Colonel Thomas Tabb of Hampton, Va., an ex-Confederate officer, but for many years a friend and Trustee of Hampton Institute, spoke most feelingly of his own and other citizens' admiration and respect for General Armstrong, whom he had known for twenty-five years and more, since he came to Hampton as officer in charge of ten counties of Virginia, under the Freedman's Bureau, in care of "refugees, Freedmen, and abandoned lands." "He came in the dark days, when the ex-Confederate and the widows, and childless were returning to the deserted homes. Courts were shut; the Bureau administered justice. Many were embittered. He had a difficult position. But he impressed us at once as no man had done, as a true, brave, just, impartial man, fearless of consequences, impartially just to white and colored. Sweet memories come to me of his goodness to those who needed it. The bravest are the tenderest. These magnificent buildings tell the story of his accomplishments; more than that, the hundreds of young men and women who all through this land have gone to elevate their people. They are his monument. People of every class, condition, and race stood by his grave to do him reverence. It is my pride to have known this great man for twenty-five years, a man of intense, earnest enthusiasm and of superior judgment, a man of utter self-forgetfulness—this is a hero. Like Christ himself, he gave his splendid life to his country, to humanity, to God."

From the story of "Hampton's Twenty Two Years," already referred to, the following extracts are taken. In view of recent incidents occurring in connection with Hawaii, the fact that General Armstrong was native born to the islands, and that his early life was passed there, lends present interest to his words. His evident life training for the great work he was to do at Hampton, is suggestive and impressive. The childhood of this son of missionary parents, passed among these simple heathen people; the later experience of the negroes, acquired during the war for the Union, which brought so closely under his observation the enslaved Africans; all fitted him, as perhaps no other man in the whole country was fitted, to successfully undertake the unique enterprise of attempting to civilize two alien races. Such preparation and such success give weight and authority to his words.

In the preface to the work from which these autobiographical notes are taken, reference is made to a former publication issued by Putnam's, New York, in 1873, entitled "Hampton and its Students;" and the condition then, with that in 1893, is thus contrasted:

Since that time, its buildings have increased from five or six to over forty; its students from 175 to 650 boarding students, representing twenty-two states and territories; it is known as the first of the modern Eastern Schools for Indians as well as the first Southern School of its kind for the freedmen, and, with its representatives of nine other races or nationalities—Afro-Cuban, Russian, Native African, Armenian, Persian, Chinese, Japanese, Australian and Hawaiian,—may claim to have "put a girdle around the world." Graduating its first class in 1871, it has now 723 graduates (25 of them Indians), almost without exception teachers and leaders of their people, chiefly in the country districts of Virginia and neighboring Southern states. These, with at least half as many more colored under-graduates who teach and do other work, and about 345 returned Indian students, the great majority of whom have done well, are the fruit and measure of Hampton's work for two races.

The following are General Armstrong's words with which the book begins:

FROM THE BEGINNING.

[By S. C. Armstrong.]

It meant something to the Hampton School, and perhaps to the ex-slaves of America, that, from 1820 to 1860, the distinctively missionary period, there was worked out in the Hawaiian Islands, the problem of the emancipation, enfranchisement and Christian civilization of a dark-skinned Polynesian people in many respects like the Negro race.

From 1831, my parents, Richard Armstrong of Pennsylvania and Clarissa Chapman of Massachusetts, were missionaries, till my father's appointment, in 1847, as Minister of Public Instruction, when he took charge of, and in part built up, the five hundred Hawaiian free schools and some of the higher educational work, until his death in 1860.

Born there in 1839, and leaving the country in 1860, to complete my education under Dr. Mark Hopkins at Williams College, Mass., I had distinct impressions of the people, of the work for them and of its results. Let me say here, that whatever good teaching I may have done has been Mark Hopkins teaching through me.

On horseback, and in canoe tours with my father and alone, around those grandly picturesque volcanic islands, inspecting schools and living much among the natives (then generally Christianized), I noticed how easily the children learned from books, how universally the people attended church and had family prayers—always charmingly hospitable; and yet that they lived pretty much in the old ways; all in one room, including the stranger within their gates, who usually had, however, the benfit of the raised end and a curtain. They seemed to have accepted, but not to have fully adopted, Christianity; for they did not have the conditions of living which make high standards of morality possible.

While far above the plane of heathenism, most of its low and cruel practices having disappeared, and while they were simple and sincere believers, contributing of their substance to the churches more, in proportion, than any American community of which I now know, they could not, under the circumstances, keep up to a high level of conduct; the "old man" in them had pretty much his own way. They were like the people to whom the epistles of the New Testament were written: they were grown up children.

To preach the Gospel rather than to organize living was the missionary idea. Devoted women visited their houses, and practical morality was thundered from the pulpit. "Let him that stole steal no more," or the like, was the daily precept, followed by severe church discipline; but houses without partitions, and easy-going tropical ways, after generations of licentious life, made virtue scarce.

They were not hypocrites, and, from their starting point, had made a great advance. "Our saints are about up to your respectable sinners," said a returned missionary.

Illustrating two lines of educational work among them, were two institutions: the Lahaina-luna (government) Seminary for young men, where, with manual labor, mathematics and other higher branches were taught; and the Hilo Boarding and Manual-labor (missionary) School for boys, on a simpler basis, under the devoted David B. Lyman and his wife. As a rule, the former turned out more brilliant; the latter, less advanced but more solid men.

In making the plan of the Hampton Institute, that of the Hilo School seemed the best to follow.

Mr. Lyman's boys had become among the best teachers and workers for their people; while graduates of the higher school, though many had done nobly at home and in foreign fields, had frequently been disappointing.

Hence came our policy of only English and generally elementary and industrial teaching at Hampton, and its system of training the hand, head and heart. Its graduates are to be not only good teachers, but skilled workers, able to build homes and earn a living for themselves and encourage others to do the same.

WAR EXPERIENCES WITH THE FREEDMEN.

Two and a half years' service with Negro soldiers (after a year as Captain and Major in the 125th New York Volunteers)—as Lieut. Colonel and Colonel of the Ninth and Eighth Regiments of U. S. Colored Troops, convinced me of the excellent qualities and capacities of the freedmen. Their quick response to good treatment and to discipline, was a constant surprise. Their tidiness, devotion to their duty and their leaders, their dash and daring in battle, and ambition to improve—often studying their spelling books under fire—showed that slavery was a false, though doubtless, for the time being, an educative condition, and that they deserved as good a chance as any people.

In March, 1866, I was placed by General O. O. Howard, Commissioner of the Freedmen's Bureau, in charge of ten counties in Eastern Virginia, with headquarters at Hampton, the great "contraband" camp; to manage Negro affairs and to adjust, if possible, the relations of the races.

Colored squatters by thousands and General Lee's disbanded soldiers returning to their families, came together in my district, on hundreds of "abandoned" farms which government had seized and allowed the freedmen to occupy. There was irritation, but both classes were ready to do the fair thing. It was about a two years' task to settle matters by making terms with the land-owners, who employed many laborers on their restored homes. Swarms went back on passes to the "old plantation," with thirty days' rations, and nearly a thousand were placed in families in Massachusetts, as servants, through the agency of a "Home" in Cambridgeport, under charge of a committee of Boston ladies.

THE NEGROES SUCCESSFULLY MADE TO BE SELF SUSTAINING.

Hardest of all was to settle the ration question; about two thousand, having been fed for years, were demoralized and seemed hopeless. Notice was given that in three months, on Oct. 1, 1866, all rations would be stopped, except to those in hospital, for whom full provision was made. Trouble was expected, but there was not a ripple of it, or a complaint, that day. Their resource was surprising. The Negro in a tight place is a genius.

It was my duty, every three months, to personally visit, and report on the condition of the ten counties; to inspect the Bureau office in each, in charge of an army officer; to investigate troubles and to study the relations of the races. The better class of whites were well disposed, but inactive in suppressing any misconduct of the lower class. Friendliness between the races was general, broken only by political excitement, and was due, I think, to the fact that they had been brought up together, often in the most intimate way, from childhood: a surprise to me, for, on missionary ground, parents, with the spirit of martyrs, take every pains to prevent contact of their children with the natives around them.

Martial law prevailed; there were no civil courts, and, for many months, the Bureau officer in each county acted on all kinds of cases, gaining, generally, the confidence of both races. When martial law was over and the rest were everywhere discontinued, the Military Court at Hampton was kept up by common consent, for about six months.

Scattered families were reunited. From even Louisiana—for the whole South was mapped out, each county officered, and as a rule, wisely administered—would come inquiries about the relatives and friends of one who had been sold to traders years before; and great justice and humanity were done in bringing together broken households.

CREDIT GIVEN TO GENERAL HOWARD AND THE FREEDMEN'S BUREAU.

General Howard and the Freedmen's Bureau did for the ex-slaves, from 1865 to 1870, a marvellous work, for which due credit has not been given; among other things, giving to their education an impulse and a foundation, by granting three and a half millions of dollars for school houses, salaries, etc., promoting the education of about a million colored children. The principal Negro educational institutions of to-day, then starting, were liberally aided, at a time of vital need. Hampton received over $50,000.00 through General Howard, for building and improvements.

On relieving my predecessor, Capt. C. B. Wilder, of Boston, at the Hampton headquarters, I found an active, excellent educational work going on under the American Missionary Association of New York, which, in 1862, had opened, in the vicinity, the first school for freedmen in the South, in charge of an ex-slave, Mrs. Mary Peake. Over fifteen hundred children were gathering daily; some in old hospital barracks—for here was Camp Hamilton, the base hospital of the Army of the James, where, during the war, thousands of sick and wounded soldiers had been cared for, and where now over six thousand lie buried in a beautiful National

Cemetery. The largest class was in the "Butler School" building, since replaced by the fine "John G. Whittier School-house."

HISTORIC SITUATION OF HAMPTON.

Close at hand, the pioneer settlers of America and the first slaves landed on this continent; here Powhatan reigned; here the Indian was first met; here the first Indian child was baptised; here freedom was first given the slave by General Butler's famous "contraband" order; in sight of this shore, the battle of the "Monitor" and "Merrimac" saved the Union and revolutionized naval warfare; here General Grant based the operations of his final campaign. The place was easily accessible by railroad and water routes to the North, and to a population of two millions of Negroes; the centre of prospective great commercial and maritime development—of which Newport News, soon to have the largest and finest ship yard in the world, is beginning the grand fulfilment—and, withal, a place most healthful and beautiful for situation.

I soon felt the fitness of this historic and strategic spot for a permanent and great educational work.

The suggestion was cordially received by the American Missionary Association, which authorized the purchase, in June, 1867, of "Little Scotland," an estate of 125 acres (since increased to 190), on Hampton River, looking out over Hampton Roads.

GENERAL ARMSTRONG UNEXPECTEDLY CALLED TO THE WORK.

Not expecting to have charge, but only to help, I was surprised, one day, by a letter from Secretary E. P. Smith, of the A. M. A., stating that the man selected for the place had declined, and asking me if I could take it. I replied, "Yes."

Till then my own future had been blind; it had only been clear that there was a work to do for the ex-slaves, and where and how it should be done.

A day-dream of the Hampton School nearly as it is, had come to me during the war a few times; once in camp during the siege of Richmond, and once one beautiful evening on the Gulf of Mexico, while on the wheel house of the transport steamship "Illinois," enroute for Texas, with the 25th Army (Negro) Corps for frontier duty on the Rio Grande river, whither it had been ordered, under General Sheridan, to watch and if necessary defeat Maximilian in his attempted conquest of Mexico.

The thing to be done was clear: to train selected Negro youth who should go out and teach and lead their people, first by example, by getting land and homes; to give them not a dollar that they could earn for themselves; to teach respect for labor, to replace stupid drudgery with skilled hands; and, to these ends, to build up an industrial system, for the sake not only of self-support and intelligent labor, but also for the sake of character. And it seemed equally clear that the people of the country would support a wise work for the freedmen.

I think so still.

The missionary plan in Hawaii had not, I thought, considered enough the real need and weaknesses of the people, whose ignorance alone was not half the trouble. The chief difficulty was, with them, deficient character, as it is with the Negro. He is what his past has made him; the true basis of work for him, and all men, is the scientific one—the facts of heredity and surrounding: all the facts of the case.

There was no enthusiasm for the manual labor plan. People said, "It has been tried at Oberlin and elsewhere, and given up; it don't pay."

"Of course," said I, "it cannot pay in a *money* way, but it will pay in a *moral* way; especially with the freedmen. It will make them men and women as nothing else will. It is the only way to make them good Christians."

The School has had, from the first, the good fortune of liberal-minded Trustees, who accepted its unformulated, practical plan when it opened in April, 1868, with two teachers and fifteen pupils, and adopted my formal report of 1870,* the year of its incorporation under a special Act of the Assembly of Virginia.

SELF HELP, THE FUNDAMENTAL IDEA OF HAMPTON.

By the Act of Incorporation, the School became independent of any association or sect, and of government. It does work for the state and general government, for which it receives aid, but is not controlled or supported by them.

From the first, it has been true to the idea of education by self-help, and I hope it will remain so. Nothing is asked for the student that he can provide by his own labor; but the system that gives him this chance is costly. The School depends on charity for $60,000.00; the student gets nothing but an opportunity to work his way. While the work-shops must be made to pay as far as possible, instruction is as important as production.

Steadily increasing, its full growth, just reached, is 650 boarding students, from 24 states and territories, averaging 18 years of age, 136 of them Indians; 80 officers, teachers and assistants, of whom half are in the eighteen industrial departments and shops; 300 children in the "Whittier" (primary) department.

THE COST OF THE SCHOOL TO THE PUBLIC.

The School is maintained at a total annual cost of about $155,000.00. Deducting the labor payments of Negro students, (say $55,000.00), $100,000.00—which is $154.00 apiece—is the net annual cost to the public. This is provided, 1st by annual appropriation from Virginia of $10,000.00, interest on the State Agricultural College land-fund (Act of Congress, 1862;) 2nd. by an appropriation of $20,000.00 by Congress for the maintenance of 120 out of our 136 Indians, at $167 apiece; 3rd, by an income of about $10,000.00 from our endowment fund (of $194,000) and from rents; 4th, by about $60,000 contributed by the people, in the form of $70 scholarships, donations for general purpose and occasional unrestricted legacies. The School is never closed, but reduced nearly one-half in the summer; many colored students go out to find work, and sixty or more Indian students have "outings," among Massachusetts farmers.

COLORED FREE SCHOOLS IN THE SOUTH.

A great stimulus to this Institute, and to all like work, has been the 16,000 Negro free schools of the South—nearly 2,000 in Virginia alone—costing the ex-slave states nearly four millions of dollars a year in taxation.

Northern charity, at the rate of about a million dollars a year, with liberal Southern state aid in some cases, is supplying over twenty strong Normal and Collegiate institutes, mostly under church auspices, where not far from 5,000 adult select Negro youth of both sexes are being fitted to teach and lead their people—industrial education being more and more appreciated and introduced. The Slater Fund has been a great stimulus to their technical training. The Negro girl has proved a great success as a teacher. The women of the race deserve as good a chance as the men.

So far, it has been impossible to supply the demand for Negro teachers. School houses and salaries, such as they are, are ready; but competent teachers are the great and pressing need, and there is no better work for the country than to supply them.

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* Reprinted in my Report of 1889-90.

But the short public school sessions, of from three to seven months, do not give full support, and skilled labor is the only resource of many teachers for over half the year. As farmers and mechanics, they are nearly as useful as in the school room. Hence, the importance of industrial training.

Hampton's 720 graduates, discounting ten per cent. as disappointing, with half that number of under-graduates, are a working force for Negro and Indian civilization. To fit them for this field has cost, since April, 1868, the round sum of $1,350,000, not including endowments, of which over $500,000 is represented by the School's "plant" which is good for generations to come.

Every year, an account of funds received has been rendered in detail.

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FIRST INDIAN PUPILS RECEIVED IN 1878.

It was not in the original plan of the School that any but Negroes should be received, though the liberal state charter made no limit as to color; but when, in 1878, a "Macedonian cry" came from some Indian ex-prisoners of war in Florida—once the worst of savages—through Capt. R. H. Pratt, whose three years' wise management of them in Fort Marion had resulted in a wonderful change, seventeen were accepted, at private expense, Bishop Whipple providing for five of them. The Hon. Carl Schurz, then Secretary of the Interior, was quick to appreciate the success of their first few months at Hampton, and sent us more Indians, from the West; then Congress, on the strength of the results at Hampton, and of Capt. Pratt's proved capacity, appropriated funds to start the great work at Carlisle, where over five hundred Indian youth, under Capt. Pratt, are being taught the "white man's way."

THE EXPERIMENT A SUCCESS.

The annual Indian attendance at Hampton is now 136, of whom 120 are aided by government, the rest by charity. The results are reported elsewhere in this book, by Miss Folsom. The death rate, once alarming, has, for six years, been not quite one a year. Of the 345 returned Indians, but 25 are reported as unsatisfactory, but four of them bad; the rest are employed as Farmers, Catechists, Preachers, Teachers, Mechanics, Clerks, etc.; 35 seeking further education, six of them in Eastern Normal Schools and Colleges, and 42 of the girls are married, in good homes.

The old homesickness of Indians at Eastern schools is nearly over. The three years' period at school, which was formerly too much like a prison term, is more and more ignored and the idea of fitting for life, whatever time it takes, gains strength. Indians are no longer coaxed to come. Twice as many as we can take wish to come; yet the really desirable ones are not very many, and we do not care to increase our numbers. Our Indian work is illustrative rather than exhaustive.

Hampton's work for the "despised races" of our country, while chiefly for the Negro, is really for all who need it,

Till our limit is reached, any youth in the land, however poor, can come here and work his way.

GENERAL ARMSTRONG'S TRIBUTE TO HIS ASSOCIATES.

In this review, I cannot but refer to my associates, without whom this work could not have been what it is; too little credit has been given them: the men and women who, for twenty-two years have labored with noblest zeal, have enjoyed the privilege of such work and are thankful for it.

The present efficient force of officers and teachers could manage successfully every department of the school, should its head be taken away. In twenty-two years it has attained a life of its own; it would be poor organization and develop-

ment that would not, in that time, have reached this point. It might once have been, but is not now run by "one man power."

The change will come and the school will be ready for it.

FORTUNATE LOCAL SURROUNDINGS AND CONDITIONS.

We have been fortunate in our neighbors, who from the first have been most friendly. The wide awake town of Hampton, with an enterprising white community, has a Negro population of about three thousand, and illustrates, as well as any place in the South, the formation of two classes among the freedmen; the progressive and non-progressive. For miles around, the country is dotted with their hard earned homesteads; yet the "shiftless" class is large. There is little race friction and steady improvement.

Adjoining our grounds is the National Soldiers' Home, with its 3,000 army veterans, Gov. P. T. Woodfin in charge; and, two miles distant, is the U. S. Artillery School at Fort Monroe, Col. Royal T. Frank, commanding, where a large detail of Army Officers is sent every two years to pursue professional studies.

The Hygeia Hotel and an extensive new one now building at Old Point Comfort, have been and will be the means of bringing many to see and become interested in the work of this School.

Full of resources, this famous Peninsula, comparatively dormant for two hundred and fifty years, is awakening to a wonderful development, especially along its magnificent harbor front on Hampton Roads and the James River. From historic Yorktown, Old Point Comfort, Newport News, and up to Jamestown island, where stands the oldest ruin of English civilization on this continent, have already sprung at points, large commercial, national and educational enterprises and institutions. Thousands flock to these shores, winter and summer, for rest and recreation. The growth has only begun.

This new life and energy but typify the awakening of the whole South under the ideas which won in the war.

The "Boys in Blue" did a fearful but necessary work of destruction. "It is for us to finish the work which they so nobly began," said Lincoln at Gettysburg.

The duty of the hour is construction; to build up. With all credit to the pluck and heroic self-help of the Southern people, and to Northern enterprise for railroad. mineral and other commercial development, the great constructive force in the South and everywhere is the Christian teacher. "*In hoc signo vinces*," is as true now as in the days of Constantine.

Let us make the teachers and we will make the people.

The Hampton Institute should be pushed steadily, not to larger, but to better, more thorough effort, and placed on a solid foundation. It is big enough, but its work is only begun. Its work, with that of other like schools, is on the line of Providential purpose in ending the great struggle as it did; the redemption of both races from the evils of slavery, which, while to the Negro educative up to a certain point, was a curse to the country.

God said: "Let my people go;" and it had to be done.

Hence this work, to which Hawaii, raised from heathenism by American missionaries, is glad to make her contribution.

From a most interesting statement by one of his colleagues the following extracts are quoted:

REMINISCENCES.

[By J. F. B. Marshall.]

The fourteen years spent by me as treasurer and resident trustee of Hampton Institute, were a valuable part of my education, and are among the most satisfactory years of my life, now past the Psalmist's limit. It is a pleasure to recall them.

Forty-three years ago, Samuel C. Armstrong was a restless member of my Sunday School class of eight year old boys, in good Father Damon's "Seamen's Bethel," then the only English Church in Honolulu. His father, Rev. Richard Armstrong D. D., one of the early American Missionaries, had entered the service of the Hawaiian King as his Minister of Public Instruction, with whom I, as chairman of the Committee on Education of the Hawaiian Parliament, was brought into close relations. Neither of us then dreamed that this boy and I would ever be associated in Negro and Indian educational work in Virginia, and that I should sit as a learner at the feet of my former pupil.

Indeed, the Hampton system, with its grand results, has been an education to the whole country, the value of which cannot be overestimated.

In June, 1869, I received from Mrs. Choate and Miss Quincy seventy dollars, which were the first Boston contributions for the Hampton School of which I have any knowledge.

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FIRST VISIT TO HAMPTON.

In June, 1870, I visited Hampton for the first time, to see what my former Sunday school pupil was trying to do for the freedmen of the South, after the civil war, in which he had taken an active part. I became so deeply interested in the work, that I accepted the invitation of my fellow trustees to become the resident trustee. I found the School located on a charming and historic spot, not far from where the first cargo of African slaves was landed; with about fifty colored pupils of both sexes, to whom Gen. A. was giving just the training which they needed. It was not just the training which a majority of the students thought they needed. It was not just the training a majority of the trustees thought should be given, or what the leading colored men of the country then approved of. Instead of Greek and Latin roots, the boys planted and dug potatoes, while the girls were taught to make and mend clothing, and all were instructed in the rudiments of a plain English education. The trustees had yielded to his energy rather than to his arguments. They saw that, if he was to do the work, he must be allowed to do it in his own way, even though it was against their judgment. On the board of trustees, were experienced educators, who were startled at the radical innovations proposed by this young and inexperienced leader. The venerable President Hopkins of Williams College of which Gen. A. was a graduate, and Gen. Garfield, also a Williams' graduate and ex-President of a college in Ohio, then a member of Congress and trustee of the school, advised the adoption of Gen. A's plans, saying that he would not be satisfied till he had tried them, and that, if they proved failures, he would be the first to see and abandon them. And thus the Hampton School System, the wisdom of which is now universally acknowledged, was adopted.

THE SMALL BEGINNINGS OF A GREAT ENTERPRISE.

At the time of my first visit, none of the school buildings, which now cover almost all the available space, were erected. The old barracks, built during the war for hospital purposes, had been converted into dormitories, chapel, dining rooms, kitchen, class and industrial rooms, barns and stables. The brick walls of Academic Hall, the first school building erected, were partly up. The old Mansion House had been made habitable for the few teachers then employed, among whom Miss Rebecca T. Bacon of New Haven, Conn., lady principal, Francis Richardson of Philadelphia, who laid out the grounds, set out shrubs and trees, managed the farm and the business of the school and gave agricultural lectures, and Miss Jane Stuart Woolsey of New York, who gave several years of voluntary and valuable service in organizing the Girls' Industrial Department, are gratefully remembered. The house was of the old plantation [illegible] piazzas and lofty pillars on two sides. When the young Principal brought his young bride to share and lighten his

burdens, the only way in which rooms could be provided for the newly married pair was by boarding up one of the broad piazzas, which gave two small rooms in each story. These rooms are still occupied by Gen. Armstrong and his family.

A substantial brick building near by, formerly a steam mill, was fitted up as a dormitory for the girls and the Matron, through the self-denying generosity of Mrs. Stephen Griggs of New York, after whom it was named.

This was the day of small things. The School at first found few friends in the locality, and was looked upon as a most unwelcome intruder. Property in its vicinity was thought to be depreciated in value because of its proximity. All this has been changed. Lots near the School have doubled and trebled in value, and are now in great demand. Through the wisdom of its management, the School has gained the confidence of the people of Hampton, with whom its relations are entirely satisfactory.

THE EXPERIMENT WITH INDIAN PUPILS AND ITS GRAND RESULT AS SEEN IN THE FAMOUS SCHOOL AT CARLISLE, PENNSYLVANIA.

When, in 1878, Gen. Armstrong was asked to receive into his school some of the Indian prisoners who had been confined at Fort Marion, St. Augustine, I was not in favor of the plan. I had little faith in the capacity of the red man for civilization, and felt too that Gen. A. had already as much on his shoulders as he could well carry. I think a majority of the trustees were of the same opinion. It was well for the country and for the cause of Indian civilization that our objections were overruled. The childlike docility, capacity to learn, and readiness to adopt the ways of civilization, or as they poetically expressed it, "to walk in the white man's road," of these savage warriors who had come to their Eastern prison with bloody hands, were a revelation to the great majority of our citizens, who had heretofore only associated the red men with scalping knives, tomahawks and treachery, President Hayes, with Carl Schurz and others of his Cabinet, visited Hampton, and was so impressed with the hopefulness of this experiment in Indian industrial training, that he determined to make it a special feature of his administration, and Capt. Pratt was sent to the reservations to bring fifty children of both sexes to Hampton. Out of this beginning grew the now famous school at Carlisle, and other Eastern schools, to the influence of which is mainly due the great advance of public sentiment concerning the education and industrial training of our Indians, for which Congressional appropriations have steadily increased from $20,000 in 1876, to $1,806,726.00 in 1889.

When, ten years after the Custer Massacre, "Rain-in-the Face," the hero of Longfellow's poem, applied for admission as a pupil into the Hampton School, I enclosed the letter to Mr. Whittier, suggesting it as a good subject for a peace poem, in contrast to the war poem of Longfellow. He acted upon the suggestion, and in the Atlantic Monthly of April, 1887, appeared his lines "On the Big Horn." Both these poems are popular with the Indian students and are standard material for their exhibitions.

THE FOUNDER OF THE SCHOOL AT TUSKEGEE, ALABAMA.

The young man bearing the honored name of the "Father of his country," who came, in the school's early days, to Hampton, with but fifty cents in his pocket, in search of the opportunity to earn his education which it offered, and who has since founded the remarkable school at Tuskegee, Alabama, has built Hampton's proudest monument. That scion of the parent stem, with its admirable methods, its sightly and commodious buildings planned and built by Hampton graduates, of brick and lumber manufactured on the premises, its agricultural and other industries for both sexes, with its thorough class training, is a triumphant vindication

of Gen. Armstrong's views and methods, which the grand work done all over the South and on the Indian reservations by Hampton graduates but emphasizes and confirms.

The friends of Hampton and of its indomitable Chief who has given his life-blood in its service, may well be satisfied with these results.

The extracts which follow, comprise a large part of the latest report made by General Armstrong to the Trustees of the Institute, which was completed shortly before his death:

HAMPTON NORMAL AND AGRICULTURAL INSTITUTE.

TWENTY-FIFTH ANNUAL REPORT OF THE PRINCIPAL FOR THE SCHOOL AND FISCAL YEAR ENDING JUNE 30, 1893.

To the Trustees of the Hampton Normal and Agricultural Institute:

GENTLEMEN: When at the close of the war, twenty-eight years ago, four millions of low, ignorant Afro-Americans were thrown upon their own resources and upon the country's care, our civilization received its severest test, and there was the added strain of disbanding armies and broken-up social and economic conditions. But, naturally and quietly as the rivers flow to the sea, the soldiers of both armies went to their homes, and to steady, manly living; war horses pulled the plow; the ex slaves went to work or to school as they had the opportunity, and a "New South," based on order, industry and general justice and intelligence, has nobly developed. The four millions of freedmen have become nearly eight millions of people, having made a marvelous record of progress in the quarter century closing in 1893.

How clear now to all is the Providential idea that the great civil war meant not only the welfare and progress of one race, but of the entire nation, and of mankind. Only in the remote future will its far-reaching intent and bearing as an education be understood. The following facts from the Bureau of Education at Washington, were foreshadowed, predestined, but not even dreamed of, when, in 1862, the American Missionary Association of New York opened the first school for slave children at Hampton, Va. Then there were no Negro schools in the land; now there are 24,150 nearly, under Negro teachers. A million and a third children are at school: there are 175 schools above the primary or common grade, in which there are 35,000 children and 1,311 select Northern teachers giving an advanced grade of instruction.

Over two million colored children have learned to read and write in a public school system as firmly established in the ex-slave as in the Northern states, supported by local taxation whose total, since 1870, has not been far from fifty million of dollars; now, at the rate of eleven millions a year. Northern charity since 1862, for the same purpose, may be estimated at twenty-five millions of dollars; now at the rate of about a million dollars yearly.

WHAT THE FREEDMEN HAVE ACCOMPLISHED IN THEIR FIRST QUARTER OF A CENTURY OF FREEDOM.

From utter poverty in 1865, the ex-slaves have accumulated, to the present time. over two hundred million dollars worth of property. Getting land and knowledge has been their passion; they have not thrown a pauper upon the nation; while, for their education, but a paltry three and a half million of dollars of government money has been expended—this, through the Freedmen's Bureau before 1870, with the happiest results. As a race, the colored people of the country ask for nothing by way of bounty, and for no material or political advantages. They do not expect legislation that shall be of the slightest advantage to them, while it is clear that the Postal Savings Bank system would help them greatly. While the national feeling of responsibility for them has disappeared, there is still a strong individual feeling,

expressed from time to time in noble charity in their behalf. Dropped as wards of the nation, they are still the people's wards, and for a long time will need and get helpful care in their noble efforts to help themselves to better living. They ask only for a "Fair Chance." They never beg for anything but for a chance to work their way through school. Such applications are overwhelming; some must be rejected for want of room. The young Negro woman is the most needy and unfortunate and should have a larger opportunity. Our country's noblest mission is to leaven and lift up the weaker, less favored and despised classes in our midst.

The Hampton School's first quarter century, from 1868 to 1893, covers the most interesting, difficult but hopeful period of development as well as of national progress. Our social, political and economic problems have been bravely faced; more brain and wealth devoted to their solution than ever. That the initiative of progress was received in slavery, even the thoughtful Negro admits, for, in the intimate contact of the black and white races, civilized ideas were imbibed. The greatest benefit acquired by the former was a knowledge of the English language, with industrial training, and a knowledge of Christianity; a very imperfect education, but a start that counted for much, of far more advantage to the blacks than the contact of the whites has been to the red race. While developing the Negro, civilization has nearly annihilated the Indian. Anglo Saxon sensuality and selfishness—human nature, in short—has acted and reacted; the wrong doer has been the greatest sufferer morally, made much money unjustly, but all things have worked together for good. We should not too lightly estimate the opportunity given the Negro when his master left him to manage the plantation in order to go to the war. This was highly developing, made a step in advance, and he was, so far, better fitted for responsibility. The good conduct of the Negro at that period has won him the lasting gratitude and respect of the Southern people. It is unparalleled in history.

THE INDUSTRIAL TRAINING FORMERLY GIVEN IN SLAVERY MUST NOW BE SUPPLIED BY SCHOOLS.

Slavery had its good side, but was, in many ways, a hard, bad school; worse for the master than for the slave. It was a good school for teaching trades; trained a host of good mechanics who do the work of the South. While ruinous to the soil, which it abused and exhausted, it supplied an army of mechanics whose places young colored men should be trained to fill. A large per cent., no doubt one-fourth, of the two hundred thousand Negroes who were enlisted as soldiers, learned to read. The spelling book was always carried with the rifle; often studied under fire. Army life was useful to them in many ways. No lawlessness was ever charged to the disbanded volunteers; while the several Negro regiments of the regular army have made a fine record; bearing well any comparison.

The locomotive has been a civilizer quite as much, perhaps, as the school house. Railroads and other enterprises in the South, developing its resources, scattering enormous amounts of wage money, creating new values and better conditions for industry, have benefited both races alike, and have, with the spirit and pluck of all classes, made the "New South," whose grand fulfilment we have only begun to see illustrated; nowhere so well as in this peninsula, of which Newport News is the commercial centre and capital.

As was stated, common schools for Negro children received their initiative at this place, in 1862. Here industrial education for the Negro, suggested by a foreign experience, was first begun, has received its largest development, and in 1878 the Hampton School, through the co-operation of Hon. Carl Shurz, then Secretary of the Interior, was pioneer as an industrial school for Indians, received the first red youth in any considerable number separated from barbarism and educated away from their homes. The great Indian work at Carlisle and elsewhere rapidly followed under the impulse here given. The genius of Capt. R. H. Pratt inspired the

admirable system of "Outing" of Indians among farmers, grandly carried out at Carlisle and practiced here since 1878.

Fittingly has work been done here for both races. Here, or near Hampton, English civilization first touched American soil; near here the first slaves were landed, and here freedom began. Here, where white, red, and black people first met, the white man began the conquest of the continent, a conquest characterized chiefly by sensuality and selfishness—the red man was doomed to disappear; and the black man, made a social pariah, has had a hardly easier fate. Is it not right that Christian education should spring up here where freedom and education began? Should its appeal for the means of making self reliant manhood and true useful womanhood, through endowment, perpetually possible for these weaker peoples, lag through another quarter century? Having a third of the needed million dollars, how long must it wait for the rest? I earnestly hope that in this Columbian year, this school's endowment may reach the sum of at least half a million dollars. While this and other countries are filled with admiration and wonder at ourselves for the tremendous achievements of America in the past four hundred years, whose completion this year celebrates, it is well to remember that on our part, there has been a "century of dishonor," and that about the most wonderful product of our literature has been the remarkable story entitled "Uncle Tom's Cabin," based on the experience of a people brought here against their will. Will the nation's conscience and benevolence be quickened like its pride?

THE GROWTH OF HAMPTON INSTITUTE.

It has often been stated that the Hampton Institute opened in April, 1868, with two teachers and fifteen pupils. It now requires about eighty teachers in all departments, about half of them industrial, and provides regularly for 650 boarding pupils of whom 130 are Indians from New York State and the West, with 300 in the "Whittier" or primary department. So much for growth. What of results?

WHAT HAMPTON GRADUATES HAVE DONE AND ARE DOING.

For the past four years we have been gathering, through correspondence, the facts regarding the 723 graduates of the school from 1871 to 1890, which are just published in a book of 520 pages, printed by our students, entitled "Twenty-two Years' Work of the Hampton Institute." It really shows the results of the school's first quarter century of work. Five maps, notably the "Star map," indicate the facts, which briefly stated, are that 129,475 pupils have been taught by our graduates, two thousand of whom have been teachers, (150,000 pupils taught would be a fair estimate.) The thrift of these graduates has made their reported accumulations $167,855. Of forty-five the record is unsatisfactory; we know of but three who have been criminals. Not a single grievance has been mentioned by a graduate teacher, not an "outrage" has been reported in their wide field of work. Great fairness and kindness on the part of public school officers, and general good feeling, universal cheerfulness and hope, have characterized their correspondence, which is encouraged and responded to in a special department of this school. A lamentable weakness of intelligent organized effort to improve the ignorant, poverty stricken, and whiskey drinking condition of the people is reported on all sides; to meet which has been organized, as recommended in my last report, a Missionary Department of the School, of which Rev. H. B. Turner, Assistant Chaplain, has taken charge. His aim is to secure the co-operation of graduates in the wide field, who shall build up Sunday-school, Temperance and other work, and, so far as good example, teaching and influence can do it, tone up and improve the low conditions around them. Not the least good to come out of this will be the selecting of the right student material for the School; for there is a lack of the first rate material, especially of young

men of the right parts, who should be picked out of the thousands and thousands over the land who would gladly work all day, ten hours, and study at night, to get an education and a trade; but it takes hundreds of square miles and millions of people to produce one first rate man.

I would state again that the sum of one hundred thousand dollars is needed to place our Missionary Department on a solid, permanent basis. The income from that would sustain a working force from which large and happy results might be expected. I refer you to Mr. Turner's report below. The plan is to make our graduates an army of Christian workers. In discussing the results of Hampton's quarter century of work, there is great satisfaction in pointing to the schools and institutions built up by its graduates, in the line of its ideas, at Tuskegee, Ala., at Cappahosic, Gloucester Co., Va., at Lawrenceville, Va., at Kittrell, N. C.; the last three by undergraduates. Other like work is being planned. At these schools excellent, growing, telling, creative work is being done by our former students; notably at Tuskegee, where there have been forty of them; while from our workshops and classrooms have gone other men and women who are effective industrial and moral educators in Florida, Kentucky, South Carolina and Texas. Several are among the best and foremost workers for the colored people of Virginia. Our work is seed sowing; essentially germinant; it multiplies itself. That is its inspiration. Our shops are especially looked to for managers and helpers of labor departments in the growing industrial education for the Negroes.

I am glad to acknowledge here the liberality and appreciation of our industrial department shown by the Trustees of the Slater Fund and am most anxious that that should be put on to the best, soundest, most effective basis, made a model work of its kind, of which there is more discussion below.

THE EVOLUTIONARY STEPS IN THE DEVELOPMENT OF EDUCATIONAL FACILITIES FOR COLORED YOUTH.

First came the common school to the Negro; next came industrial, practical education, and the next step was higher, College and professional education, for which Lincoln, Howard, Fisk and Atlanta Universities nobly stand, with others of excellent record and promise. Most of these began before 1870. No more devoted, brainy or faithful work was ever put into institutions than has been put into these. They are all sound, flourishing, excellent institutions, and ought to have permanent foundations. No one who has taught them doubts the capacity of the Negroes for higher education. I have long felt that colored physicians have been the best results from the professional training of Negroes; not to belittle their worthy educated ministry, or their many able, successful lawyers. There was and is no need of the higher education here, when every Northern college is open to the capable, earnest colored student, who in many of them has already made his mark. Hampton's development lies, I think, in being as complete and perfect as possible a Normal and Industrial Training School of the highest tone and efficiency; to teach not only how to work, but the dignity of labor, to become distinctively an aggressive power for and help to non-sectarian Christian civilization of the widest range; to supply a high and many-sided grade of teachers whose work and influence shall be, largely by example, upon the whole of life; to build up manhood and help make good citizens for the country.

The political experience of the Negro has been a great education to him. In spite of his many blunders and unintentional crimes against civilization, he is to-day more of a man than he would have been had he not been a voter. His political like his former, oppressor, is only belittled by his course; and will in the end suffer for it. Reconstruction measures were like a bridge of wood over a river of fire; because of too much political selfishness and greed, and lack of statesmanlike forecast and sound policy. Manhood is best brought out by recognition of it. Citizen-

ship with the common school, is the great developing force in this country. It compels attention to the danger which it creates. There is nothing like faith in men to bring out the manly quality.

In the twenty-five years of co-education of both sexes of colored youth, there has been no occasion to regret our policy; the moral record has been marvelous for what has not happened. We have learned to make nothing of the complexion of the skin. Mixture of blood, in our experience, counts for nothing. In fifteen years of co-education of Negro and Indian there has not been a fight or fracas or any ill feeling or bad result that I know of.

THE TRUSTEES AND TEACHERS OF HAMPTON.

The board of Trustees was organized under a liberal state charter granted in 1870. Rev. Dr. Strieby and myself are the only original members still on the board. There have been many changes by death and resignation. No body of men could have been more loyal to the interests of the school than have been its trustees. Some have been too ready to give up their places to others; there has been no "dead wood" in the board; no useless staying on, but always a high, sometimes too high, sensitiveness on that point. There have been no divided councils, no antagonisms: So in relation with many score of teachers, chiefly ladies, of various temperaments. In the past 25 years I can recall no serious difficulty or break; not that everybody has been perfectly satisfied, or that all have been completely ideal, but in the past quarter century, there has been a long pull, a strong pull, and a pull all together by our little army of teachers and workers, without a serious break or friction of any account. A reason is that there has been no politics in it all; the spirit of Christian work has been universal. Dogmatic tests have not been applied, for true workers need none. There has been no flinching from severest duty, and a good deal has gone out of some lives into the work. The names of Gen'l J. F. B. Marshall and Mr. F. N. Gilman, our faithful Treasurers, of Misses Mary F. and Charlotte L. Mackie, ex-teachers, who, with others, worked here many years, are embalmed in our school memories and traditions. A few have died in the service, patient devoted young women who wore themselves out by office drudgery. I cannot speak too highly of school graduates who have done office and other school duty with excellent success and tireless devotion.

KINDNESS SHOWN TO THE SCHOOL BY THE PEOPLE AND LEGISLATURE OF VIRGINIA.

Our neighbors have been most kind and seem to have no grievance. Whatever there was, was expressed freely in 1886, and settled by a wise and friendly committee of the Virginia Legislature most satisfactorily. This school is most fortunate in its surroundings of well-disposed, kindly people in a great commercial and geographical centre.

I cannot but ask the friends of and contributors to this school to sustain an effort to give to each teacher who shall have done ten years of consecutive work here, a year off for rest—salary to continue meanwhile. If, for instance, salary has been, $400 and board, the former to continue, but not the latter. The study and observation of those having this vacation, would, in most cases, bring back marked benefit; and their absence strengthen rather than weaken us in the end. This has not been suggested or asked for by anybody; but is it not the right, fair thing to do?

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If further personal reference is pardonable, I will say that I am still a cripple, fit only for partial duty; attending to general routine business; office work, corresponding, faculty meetings, and to boys' discipline; talking to and lecturing students, taking such time for rest and recreation as has seemed wise; working especially upon our complicated industrial system, and making some important changes.

Last year, when I felt called upon to offer my resignation for the good of the school, the Trustees took the kindest and most considerate possible action in the matter. I am ever ready to give my place to a more capable and effective successor. Time may cure my ills as it has like ones; but recovery is slow. I gained much by spending most of last winter in the South. This was made possible by the kind help of friends, coming in a kindly, spontaneous, generous way. In a work like this one cannot be ready to meet by way of prevention and care, the emergencies that come in the line of duty. The "Rainy day" is apt to find one unprepared and almost helpless, but the right thing always happens.

The Rev. Mr. Frissell, Vice Principal, has, this, as last year, carried much of my burden; making calls, holding meetings, organizing working committees, doing Treasurer's duty, besides his regular work. Rev. H. B. Turner, Associate Chaplain, with his excellent lecture and stereopticon views of the school, has made a most effective campaign of education in Northern cities, interesting many people. The appeal to the ear by the Hampton Quartette, whose old time Negro melodies are still effective, together with brief original addresses by Negro and Indian students, and the appeal to the eye through views, have been so telling and satisfactory in results, that I think it important both in winter and summer to hold meetings at the centres of population, wealth and social life, to "educate the public." A series arranged last summer in the White Mountains, New Hampshire, by Mr. Frissell, resulted very well. I must speak with special and grateful appreciation of the work of Committees of ladies and gentlemen of New York City, of Brooklyn, of Boston, Mass. and of the Hampton Clubs in Springfield, Mass., and Orange, N. Y. who, burdened with other social and philanthropic duties, have worked devotedly and successfully for this school, enlarging its circle of friends and helpers, increasing our endowment, and aiding to meet current expenses. None of them have seemed at all weary of this well-doing. This committee work is most helpful; it gives me needed relief and a chance to get well and encouragement to remain at the helm, which I should not do did not the old ship move on. My own vitality depends on that of the school.

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QUESTIONS AS TO EDUCATIONAL POLICY.

I ask your attention to two points of educational policy.

(1) The age at which students should be admitted.

(2) The right method of manual training.

As to the first, I found in the "Christian Union" these words: "Inexorable statistics show that nearly every criminal career begins between fourteen and eighteen years of age." Are we right in admitting Negro and Indian pupils between the ages of seventeen and twenty-two? I think so. One reason is that only the able-bodied and mature, Negroes especially, or those of full strength, can work their way; such are soon able, if of fair brain capacity, not only to work their way in shop and field, but to hold their own in classes. A constant "weeding out" goes on. Many must be dropped as poor material, morally, mentally or physically. Up to eighteen years of age, a youth is like a strong, spirited colt; he feels his strength; has little self-control, if without good home training; and a weak moral sense. Having probably been to school a few terms when a child and seen or felt the advantages of education or a trade, he wishes to be like others. If he really cares to be like the trained men whom he knows, he makes up his mind to have an education, and will work for all he is worth to get it. Before he knows it he is leading a heroic life; working day and night to improve; protected, developed, saved, by the routine of hard work which he has chosen because he wishes to make something

of himself. This applies to both sexes, and to all kinds of people. I prefer to have as pupils those from 17 to 22 years of age, because it is the most formative period; those younger may be more plastic, but don't "stay put" so well. There is too much putty in the early teens. Later there is better mental digestion; more will power; more bodily hardness and more intelligent, decisive, reliable choice of ends; better sticking to things and more staying power. The stronger nature, rightly directed, can accomplish more. The difficulty is to get the right material to work upon. Of whites who enter college, I believe about 40 per cent. fail to remain with the class. By weeding out and dropping, 75 per cent. of our colored pupils fail to continue, yet many return to complete the course.

THE RIGHT METHOD OF MANUAL TRAINING—PROFESSOR WARREN'S COMMENTS CONSIDERED.

A thorough teacher and experienced educator is asked, every year, to inspect and criticize our methods. Prof. Warren of Connecticut, came, saw and reported in part as follows: "I am aware that the labor department here is a growth. I am aware that many circumstances have contributed to make it what it is. I do not suppose that it is the purpose of the Trustees to modify or reduce it in size. At the same time I take it for granted that you want to know how it impresses one who has not watched its growth, but sees only its operation. This, then, is what I think of it.

"(1). It seems to me that the idea of manual training or even of trade-teaching is fundamentally opposed to money-getting. That where one is the other cannot be. If lumber is to be sold, wheelbarrows offered in the market, skilled labor must be employed, the market must be studied, and every thought centered on making a profit. Or, if not a profit, then as small a loss as possible. All this excludes the teaching of boys, except to that slight degree at which their labor is profitable."

"(2). If, on the other hand, we would make the manual work educational, we must make all our energies bend to that. No thought must be had about the money side of the question; except to prevent waste, which in itself is educational."

"I am aware that many pupils earn their living here and thereby become able later to join the school. I think that this day-working and night-studying is admirable, and if there is no other way in which this branch of the work can be kept up, I should want to think a good while before I took any step looking to its elimination."

"Whether" Mr. Warren says, "the Night School pupils could not be otherwise employed is a question to which I can give no answer." "You see, I cannot reconcile the idea of manufacturing and the idea of education."

Now, making and selling lumber is our leading industry. We manufacture at the rate of about 25,000 feet per diem or about 7 million feet a year, of yellow pine lumber; selling it in local and Northern markets. In the "Huntington Industrial Works" are 55 young men working their way, taking lessons in drawing and the use of tools, making various kinds of building material, learning how to use as perfect wood-working machinery as can be got. Machinery, materialized brain, has come South to stay and to spread broadly. The Negro must learn to use it, be educated to it, even at a risk of accident, or get behind; he is well adapted to it; he makes an excellent tradesman. Student labor, used in manufacturing, is at a serious disadvantage. It should be employed, as far as possible, in piece work, under wise, careful, business-like foremen, who shall select, discipline and train them. There are many capable colored young men seeking trades, but we must select apprentices more carefully than heretofore. Hundreds apply, but few are just right. Our missionary department brings some of our best material; through it we should get the best.

PRODUCTIVE INDUSTRY A MORAL FORCE.

Careful account keeping is at the bottom of successful school or any industries. Each foreman or manager must know just where he is, whether losing or gaining. Our plan of weekly report, that might become daily, is helpful. Account of stock taken twice a year keeps things clear. The idea of self-help can be carried out only by productive industries. Honestly giving value for value, labor becomes a stepping stone, a ladder to education, to all higher things, to success, manhood and character. Thus it becomes the *moral force* that it ought to be, for only as a moral uplifting force do I advocate such an extensive industrial system as ours, which, rightly carried out, may do incalculable moral good.

Self-made men have become so by being useful; by doing that for which there is a need, a demand. Ten hours a day for three years in one of our workshops, with constant evening study, followed by two years in our Normal class (two years of night study making one year of the Normal course) gives a good education and a fairly complete mental, manual and moral outfit.

Look into the workshops; see the skilled mechanic, with student assistants, making articles by the piece, at a fixed price, sold at an advance to a clamorous market. Examine the account book. It will show serious losses in previous years. That is now changed by new management and better outfit: Work is done only by the piece; small chance for waste or loss. The careless apprentice is "hustled" out, a new one put in his place, and after a few months' training earns wages enough to pay for his board, books and clothing; learns thrift, economy and a trade; is educated; can soon do as well as the skilled man at whose side he works. The foreman, or "boss," is chiefly concerned to see that the work is well done (else it is thrown back), that the boy has proper attention, and knows the reasons of things.

In a well-organized shop the great difficulty is to get the right "boss," under whom reasonable profit is assured with well selected students. We are trying to have ideal workshops; but ours are yet far from perfect. Give us the needed time and backing. Who can, even with ample "plant," manufacture without working capital? This has not been supplied. Do not expect us to make bricks without straw.

Shall our present system of combining instruction with production as of equal importance, be developed into its best possible condition? If not, we must face disaster. I believe the true policy is to make our productive manual training system as perfect as possible. The leading idea is to make men rather than to make money. In well-organized shops, with evening study, we can make men. The hope of the working class of our day is in evening study.

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Thanks to the generous, prompt action of the Trustees, a liberal sum, increased by the proceeds of a concert given in New York City, was raised to help our exhibit at the World's Fair in Chicago, which, under the supervision of a teacher, Miss Cora M. Folsom is, I think, creditable and effective, and will do good. It was wise to push the matter as has been done. I was unable, from absence, to do anything about it, but all has gone well. The aborigines of America and the forcibly imported natives of Africa furnish a singularly tragic chapter in American life, unique in the history of the world; and have given this country a most serious problem, one that has baffled its legislators, but which has been wisely, nobly and hopefully taken up by our Christian people; to meet and settle which the Christian devotion and spirit of the country is rising generously and grandly. Emancipated Afro-Americans and Christianized Indian citizens are our greatest national glory.

Respectfully submitted, in the hope that, at the end of the next Twenty five years of work of the Hampton Institute, it will, under God's blessing, have attained a much more perfect development than it has reached, and have sent out several

hundred more earnest workers into the wide field whose needs and claims are second to none that appeal to those who love to spend and be spent for God and country.

S. C. ARMSTRONG,
Principal.

I have great respect for and faith in technical instruction in the use of tools, in which production is wholly secondary, where things are made to illustrate a principle and which has no value except to the student. This should begin with "Sloyd" work in primary classes. We have, thanks to the Slater Fund, a Technical Carpentry Shop in which every trade boy has lessons in drawing. Though fairly well appointed now, we will perfect it so far as possible. We have one such shop in which girls are taught with great advantage and satisfaction.

Both primary, ("the Sloyd") and higher grades are desirable. Still, I think, the best manual drill, education and instruction in business-like ways are given in regular workshops, by making that which somebody wants, even in the fierce competition of markets which we have felt. This we here are trying to do. It is a hard struggle; the hardest of my life.

I hope to have time, strength and the means provided to see it through to a solid basis. I think we are on the way to that point: shall we not fight it out, no matter who or what is used up in the effort?

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This report by the Principal is accompanied with detailed reports by the heads of the several departments of the school. Mr. J. E. Davis, in making the report of the "Normal School class Work," thus describes the method adopted in instruction in drawing:

DRAWING.

This subject has been taught this year entirely from objects, the aims having been the training of the eye to see and the hand to execute truthfully.

"When once a student realizes what he sees, the struggle is half over. For the rest, it is hard at first for the untrained hand to obey the will."

The greater part of the junior work has been drawing from models, chiefly type forms, with occasionally a little furniture drawing. "In addition to the outline model drawing, the Middlers and Seniors have taken up charcoal in light and shade, making many very creditable drawings from casts of flowers, fruit and animals."

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The free hand drawing classes under Miss Pond and the mechanical drawing under Mr. F. L. Small, in charge of one of the technical shops, have shown good results.

All the trades boys have been under Mr. Small's care. The object of the work has been to give such instruction in mechanical drawing as may be applied to the different trades and to teach the pupils *to apply* the instruction; to teach pupils to be able to read and construct working models. Many of the foremen of the shops report favorably of the work in mechanical drawing as seen in its effect upon the boys in their trades.

The full detailed report on the industries taught in the Hampton School and the methods of instruction in them, is given here, as it furnishes a practical illustration of methods which are held by many good judges to have won marked success. It is believed that those interested in securing for the multitudes of neglected youth in towns and cities similar practical instruction in industries and trades may

find, in these detailed statements valuable suggestions; and, therefor, unusual space has been given to them. Attention is called to the closing paragraph of Miss Scoville's summary, in which fuller information and opportunity for personal inspection of the classes is offered to all who may desire.

Review of Industries.

There are two distinct and opposite ideas of the manner in which an industrial education should be given.

One is the idea of absolute perfection in detail, that spends days and weeks in finishing one point with no idea of the article's filling any demand, but simply for the skill it gives to the hand. This is exemplified in its highest form in the "Sloyd" method. The whole thought here is given to the power that the individual acquires by this work, not to the worth of the article made.

The other theory is the more natural, if less scientific, one of learning to do something because there is a demand for it and we have a chance to fill it. In this, too, perfection is sought for its educational value and also because there is a demand for it in life. This is the method by which every Yankee boy learns to farm.

The parent or the State that has wealth, brains and power may well take its children from the cradle and train them in the Kindergartens, Sloyd and Scientific schools and turn out at the end a man or woman ideally educated, but the great mass of mankind is forced to stand and cry "Give us a place—a chance to earn our bread." Comparatively few hope to have their boys taught, they only ask for a chance to try, a place among workers, that they may teach themselves.

Each of these schemes of learning has its advantages and neither is perfect. They stand in the same relation to each other that the so-called college man and self-made man do. The college man can do nothing unless he is also self-made; the theory-trained mechanic will amount to nothing unless he also receives the self-education of practical life.

Mr. Warren, the critic teacher, who visited us this year, says:

"It seems to me that the idea of manual training or even of trades teaching is opposed to money getting. That where one is the other cannot be. If lumber is to be sold, wheelbarrows offered in the market, skilled labor must be employed.

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This excludes teaching the boys except to that degree that shall make their labor profitable. If on the other hand we make manual education our object, we must make all our energies bend to that.

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I think this day working and night studying is admirable.

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Whether the Night School students could not be otherwise employed is a question to which I can give no answer. * * * You see I cannot reconcile the idea of manufacturing and the idea of education."

The question is here put before us fairly that industrial training must be for education only, that it cannot be made to furnish the bread and butter at the same time.

Gen. Armstrong has answered this in his pithy way by saying that "It is an education in itself to make something that the world wants."

It is this thought that should be emphasized. The first thought in all our industries is and should be the lesson in self-reliance and thrift that productive labor gives.

For even the theoretical training of our students it is better that they should be engaged in productive labor.

PRODUCTIVE INDUSTRY DEVELOPS SELF-RELIANCE AND THRIFT.

This School was founded for a race taught to work, but not to profit from its work. If it had taken a man trained for twenty years to work for others and put him to working just for practice, making articles that bring no return, whatever might have been said he could hardly realize that he had more than changed masters. Every round red cent won by his labor was a declaration of freedom. This great strong child-race needed the lesson of making money as much as it needed training. It knew how to work under task masters and direction. It was not power that it needed, but purpose, and that honest earning and spending gives.

When the School had been founded a few years, another race was brought a foundling to its doors. The Indian had not the slave idea that labor brings no returns, but an opposite idea that profit comes without work. He is fed and clothed and nothing demanded of him. To save his manhood from destruction he must be taught to work. How are you going to make him see the sense and value of such teaching? Only by showing him the sure reward of every stroke of labor, since, unfortunately, it is impossible to put him where profit can only come from labor. This being so, every one must admit that the simple fact of bringing a return for the shop and the worker has its educational value. Therefore, for the student's sake alone, the problem for the School has been and always should be how best to combine theoretical and practical training in our industrial life.

If we were teaching 600 students who are not vexed by the question of self-support we might think too much of the thought and too little of the practical value, while on the other hand if we were just a manufacturing concern we should lose all sight of education and use the man alone for his value to us.

THE HAMPTON STUDENTS PARTLY SELF SUPPORTING.

The question that was and is forced upon the helpless of this race is "How can we combine the greatest amount of education of head, hand, heart with self support."

Naturally the first answer to this was—

Here is a farm on which work is to be done, let the student do it and earn his way. To earn an education is in itself an education.

This then gives us our first division of Hampton Industries.

I. *The Industries Necessary for Self Support* whose main object is to earn the daily bread of the worker.

First under this comes the care of the 75 teachers and 600 students.

It is needless to say that every student cares for his or her own room. That these may be kept properly, they are subject to daily inspection. As far as possible, the number in a room is limited to two or three, that the idea of home and private possession may be given.

There are *75* officers and teachers living on the grounds for the care of whose rooms we have a division of workmen called *Room boys and girls.* There are 39 room girls and 22 room boys. Their work is making beds, sweeping, cleaning, etc. These workers are all from the day classes, and attend to the rooms in the three quarters of an hour between study hour and school in the morning.

On Monday they give the rooms the weekly cleaning. For this work they receive $2 00 per month,

Corridors.—Every corridor and pair of stairs is in the charge of a girl or boy, who sweeps and dusts it each day and scrubs it once in two weeks.

The ground floor of Virginia Hall is occupied by the Teachers' Home dining room at one end and the Students' dining room at the other. Below these the basement holds the great kitchen, bake rooms, etc., for providing for hungry students.

Seventy five teachers come to the Teachers' Home dining room for their meals.

The running of this dining room gives employment to ten Day school boys as waiters and ten night school boys as cooks and scullions.

Students Dining room.—This department has, this winter, averaged 632 boarders. To care for these we have had 4 cooks, 3 bakers, and 2 scullions. These work all day and go to school for two hours in the evening.

There are 37 Day Class boys to wait on the hungry throng which three times a day pours into the great dining room, and the minute the last one has finished and gone, 81 Day Class girls turn to and clear away and wash the dishes, so that in half an hour the room is ready for the next meal.

This happy, hearty, crowded, noisy dining room is not the best place for a sick or ailing student, so provision is made for them in the *Special Diet Department.*

This department, sends out the meals to the three hospitals or to students rooms when they are confined to them. There is a small dining room where students convalescing or needing special diet go on order from the resident physician, to enjoy a rather more delicate or better adapted fare of beefsteak, oat meal, milk puddings, etc., as each case demands.

From 3,000 to 5,000 meals are supplied by this department per month.

To do this work, 2 Night School girls give their whole time, while one Day School boy acts as waiter.

Turning from the dining room, the next great domestic department that demands attention is the *Laundry.* This is divided into two distinct branches, first, *The Teachers' Laundry,* under the charge of Miss Woodward.

This receives about 1,400 pieces per week during the School year. In this laundry are employed 8 work girls all day, 12 girls working one day each in the week and one outside woman who acts as a sub teacher. These girls are selected when they enter school on account of already having some knowledge of the subject.

The girls who work all day receive $15 per month in board and credit and attend Night School. The day Class girls receive $.50 per day. Miss Woodward reports that she has a nice set of girls, good at their work and conscientious.

The *Students' Laundry,* under the charge of Miss Howland, is of course much larger than the teachers', there being between 8,000 and 9,000 pieces washed per week. This includes washing for all students save Indian girls, who do their own.

To do this an average of 27 Night School girls work every day in the week, and 52 Day girls for one day each per week.

The Home Farm, Mr. Howe in charge, stretches around us on all sides. In this there are 100 acres under cultivation, the chief productions being milk and vegetables.

About 35 cows are milked, averaging from 85 to 100 gallons of milk per day. Besides supplying the School families on the place and the Dixie Hospital, a good deal is sold out side.

There are 32 horses and colts on the farm, 6 of which are boarded for outsiders. There are also 250 hogs, but much more pork is consumed by the School than the farm can supply. A large part of the poultry and eggs for the School are also raised on the place.

As to crops, there are 30 acres in clover and orchard grass, 9 in fodder, 14 in oats, 5 in rye, 9 in peas, 10 in potatoes, 7 in corn, 6 or 8 in truck and the balance in orchards, small fruits, &c. From many of these fields two and three crops will be gathered this summer. For instance, the peas will be followed by sweet potatoes, the cabbage by sweet corn, &c.

There are now on the farm 13 hands: 3 in charge of cattle, 3 in charge of barn, 1 in care of pigs, 5 acting as cart drivers and farm hands, and one working in the vegetable garden.

The Farm Wheelwright and Blacksmith Shop, under the charge of Mr. Corson, makes wagons, carts, and trucks and does the repairing and horseshoeing for the farm.

Here are 16 boys working: 13 giving all their time to their trade and going to school at night and 3 working two days each a week. Two of these boys are Indian.

Beside the home farm there is about five miles from the School, the *Hemenway Farm*, under Mr. West.

In this farm there are 550 acres devoted to grain, grass and stock raising. About 400 acres are under cultivation. This place is too far from the centres of habitations to be very profitable as a dairy or market garden farm, but it raises cattle, sheep, horses, pigs, geese, ducks, turkeys, and chickens. In this way it is a good source of supplies for the School. This year, two large incubators have been added to the farm outfit and it hopes to go into poultry raising much more extensively.

On this farm there are now 14 colored boys who work all day and are taught in the evening by Miss Clapp and Capt. Jordan. They receive both good teaching and good wages, and next year will enter either the Night or Normal schools on the home grounds.

The boys usually go on to the farm just to earn their way through school, but there are few places where they learn more useful lessons and a large proportion of them use the knowledge gained sooner or later. One of our Senior boys spoke not long since of the many questions on farming that the people bring to them when they are out teaching and how much help the farm training and agriculture classes are to them.

Although this farm work cannot now be placed among the trades, it is expected that it soon will be, with a regular corps of farm apprentices under charge of the Department of Agricultural Education, to be spoken of further on.

The Knitting Shop, under the charge of Mr. E. Jones, is under contract to furnish 10,000 dozen pairs of mittens to S. B. Pratt & Co., of Boston this year.

There are 12 Night School boys in this shop, and two Normal School boys who work only two days a week. They get 21 cts. per doz. pair of mittens, and for the first three months average only about forty cents a day, but when the trade is once learned a boy will usually make from 70 cts. to $1.00 in a day. A quick boy can learn to run one of these machines perfectly in three months and probably most of them seek it with the idea of earning their way through school, but it is one of the best things for these races to learn to handle machinery. The lessons in concentration, patience, and deftness learned here are of more value than the fact that they have learned a trade in which they can set themselves up without much capital.

The Huntington Industrial Works.—This is the largest and in many ways the most important industry on the place. It is, in a way, the power for all the wood-working and building done here as from it all the pine lumber is obtained.

The logs are brought in rafts from the Dismal Swamp and the business of the H. I. Works is to reduce these logs into all forms of lumber. The works are divided into three departments namely, *Saw Mill*, *Lumber Yard*, and *Wood-working Shops.*

The first two of these departments come under this division of our subject, as being shops in which the student while earning his living does not learn a complete trade.

In these two branches of the H. I. Works there are 10 Night School boys working every day and 10 Normal School boys each working 2 days in the week. These boys learn to keep tally, scale and measure logs, grade lumber and work the lumber machines, besides the general knowledge of machinery learned in a big saw mill. This is knowledge very necessary for this race to have if they are to compete with others in this age of machinery.

The third department of these works however must come in the next division of the industries.

The Holly Tree Inns are two little restaurants on the grounds, one for boys and one for girls. The boys' is the larger, having a regular set of boarders, (employees of the school) besides furnishing the boys with treats on which to spend their pocket money. This employs 3 students as cooks and waiters.

The girls' is more a bake shop, where one Night School girl is kept busy baking all day and whose wares the hungry girls treat themselves to after school.

Last, but not least of all, come the odds and ends who cannot be counted into any department but are bread winners and most important members of our family.

First there are 4 orderlies whose duties are manifold. They are stationed in the orderlies' room, within call of the office bell, ready to do the endless errands and odd jobs of the School. Their most important duty is that of acting as guides for the hundreds of visitors that come to us.

There is one boy employed in the commissary as clerk, general duty men who handle freight, one boy who works in the hospital, one girl who works in the Doctor's office, 3 paid night guards, 12 janitors in boys' buildings and some ten or a dozen boys earn $2 per month for the care of boats.

Summing up this division of our subject we find, on a rough estimate, that ws have 350 students working with their hands to earn the education of the head.

We do not mean to say that much is not learned by every faithful student in these departments—he or she will be a better cook, laundress, or farmer, and surely much needed lessons in promptness, and thoroughness are inculcated, but still the object in view is not to teach a trade but to get the work done, and here the principle of profit industry, each doing what he can do best, is enforced as far as possible.

Many might think in reviewing this group of industries that the student was only getting support for the head by his labor, but when you remember that as students, mechanics or business men, in nothing these races are so weak as in their sense of the value of time and material, every lesson in thrift and speed that they learn by seeing how necessary work is carried on in a systematic and business like way is of inestimable value.

THE TRADES.

We come now to the second division of the industries. Those included in this have been established for the purpose of teaching trades, but at the same time this being missionary work, we have to consider the support of the student.

Gen. Armstrong had from the very beginning the conception of a school that should offer all forms of industrial training. As the school grew and prospered he patiently worked out his thought, adding a shop at a time until we have now 11 trades taught on the grounds.

In this division comes the 3d department in the *H. I. Works—the General Carpenter Shop*—under charge of Mr. P. I. Frost. It does all kinds of wood-working such as window-sashes, doors, mantels, stairways, &c., and also all fences and buildings on the school grounds. All of this work is made practical and profitable by being done under contracts and orders.

In this shop there are 25 students who work all day and attend night school. Three have finished their trade this year and 6 begun.

No one who sees the beautiful wood-work this shop sent to the World's Fair can doubt the skill and ability acquired in it.

The Carpenter and Repair Shop, under the charge of Mr. Sugden, does the general Carpentry Work for the School.

Here are 12 students employed: 1 of these has finished his trade and is acting as under-foreman; 11 are learning the trade, 5 working every day in the week and going to Night School, 4 Indian boys working half of each day and 2 Normal School boys who give the two work days a week to their trade.

J. Wood, the under-foreman, speaking from the boys' position, says "the boys usually come meaning to get their trade, and go, but the desire for an education grows stronger every day and in the end they usually go into the Normal School for a year or two and many graduate there." All students from this Shop receive draughting lessons in the Technical Shop.

The Engineering Department under the charge of Mr. G. Vaiden, furnishes the power for running all the machinery on the grounds, supplies the steam for heating, cooking and washing, and cares for the gas house from which most of the grounds and buildings are lighted.

There are nine boys working in this department, seven from the Night School and two from the Normal School. Four of these boys are learning their trade of Practical Engineering, while five are earning their living. One of this department will graduate this June from the Normal Academic course of the School.

Next under this subject come the *Training Shops.*

The Paint Shop under Mr. J. F. Lacrosse employs 16 Indians and 3 colored students. Of the 3 colored students 2 work all day and go to school at night and 1 works only two days in the week. Of the Indians two are Normal School boys working only 2 days per week, and 14 are from the Indian School working half of each day.

This department does all the painting, varnishing and glazing on the place. The Shop pays well and at the same time attention is given to the educational idea of the trade. For the first half of the year Mr. La Crosse gave regular lectures every Monday morning. These talks covered such subjects as Primary colors, Mixing colors, Applying colors, Materials, etc.

Mr. La Crosse is so convinced of the value of these that he says if he were running a shop purely for profit, he should take time for these lessons, as he thinks it would pay.

As to the two races, he says that the Indian takes hold quicker, the Negro holds out longer and they come out about even.

The Harness Shop, under Mr. Wm. H. Gaddis, himself a graduate student of this very Shop, reports 3 colored and 3 Indian students. The colored students give their full time to trade and go to Night School; the Indians are Normal School boys who give 2 days per week.

Two thirds of the year they have been filling orders for harnesses from Mr. John Wanamaker. The other third has been devoted to local work to keep the boys busy. In the order trade they have received as high as $100 for a harness, while the local work averages about $25 for a harness.

Mr. Gaddis has taught some of the students outside of his department stitching, and has made the fine work done for the World's Fair an occasion for extra lessons in fine work.

The *Shoe Shop* under Mr. S. E. Smith, another student who learned his trade in the shop where he is now foreman, reports a total of 8 students; 5 colored from the Night School working all day, 1 colored from Normal School working 2 days per week and 2 Indians working 1½ days per week.

Most of the students who entered here came to learn the trade: 3 students have finished their trade this year and 2 will finish this summer; one has just begun. All seem earnest in their work.

Mr. Smith divides the trade years systematically and although he gives no general class lessons, yet tries to teach each individual the qualities of leather, use and divisions. One of the trade graduates of this Shop has made a good record this year in Charlotte Hall School in St. Mary's Co. Maryland, where he has taken charge of the Shoe Shops.

The *Tin Shop* is in care of Mr. Walter Baker, a last year's graduate, who is both foreman and workman, as there are now no students in the Shop. He reports having put on 5,237 sq. ft. of roofing, 323 ft. down spout, 83 ft. of gutter spout, 350 pieces of tin ware repaired; 572 new pieces of tin ware made up and one Senior boy taught how to solder.

The *Printing Office* under the charge of Mr. C. W. Betts reports a dull business year, but a good, earnest set of boys. There are in the Shop 6 colored students who

give their days to this trade attending Night School · 6 Indian boys, 5 who come in for two days in the week and one who goes to Night School and gives all his days to his trade; 8 graduates and ex-students and 4 outsiders; making a total of 24 hands.

This office does all the School printing, which, besides the two School papers this year includes the "Twenty Two Years' Work," a 500 page book giving a record of Hampton's work, and a number of weekly papers and periodicals and considerable job printing from outside.

The Pierce Machine Shops, Mr. Chas. King, in charge, report on 3 departments of labor.

1st, the *Machine Shop* proper. In this he reports 2 Indians working 2 days in the week and 7 Night School boys.

2nd, the *Blacksmithing* department where he reports 4 Night School boys and 2 Normal School Indians.

3rd, the *Woodworking* department, where he reports 2 Night School boys working all day and 4 Indians working 2 days in a week.

Mr. King who has just assumed the charge of these shops this year, has been re-organizing them with the object of improving the instruction given and of placing them on a better business basis.

The work still done in the *Machine* Shop is the manufacture of a cheap grade of tools with which Mr. King is not wholly satisfied and hopes by another year to be able to afford new patterns and a better variety of work here.

In the other two departments, *Blacksmithing* and *Woodworking*, where are made raft gear, ploughs, trucks, corn-shellers, wheel-barrows, carts, hominy mills, etc., Mr. King feels that he now has the best variety of work both for instruction of his boys, the business of the Shop and the fact that they are things the boy can make when they go out from here, without having to have much capital to start in business.

Sewing, Dressmaking and Tailoring Department, Miss M. T. Galpin, manager, reports as follows:

48 girls began work in October, of which number only three have dropped out. The work done is dressmaking, tailoring, shirtmaking and mending for 400 boys.

The under clothes needing mending are sent from the laundry and keep the mending squad busy from Tuesday till Friday. On Saturday the janitors bring in the boys' suits that need mending and the Senior girls see to it. Some idea of the amount of work done is shown by these figures: 2,331 shirts, 300 uniforms, 2,368 miscellaneous articles have been made this school year.

Miss Forsythe has this year had charge of the dressmaking department and has given lessons in draughting, cutting and basting.

Miss Galpin speaks of the marked benefit of the Whittier Sewing classes as shown in those girls who come into her department from them.

The Green House, under the care of Mr. Chas. Goodrich, reports a good set of boys, two in the winter and four this spring. These are all colored boys from the Night School. Of this set one came to learn his trade, one probably intends to finish the trade and two are simply working their way through school. One outside laborer was employed last fall but now all the work is given to the boys and the aim is that there shall be no outside help. No class instructions are given these boys but individual lessons and questions on their purpose are given to each as he works. Mr. Goodrich has this spring taken 18 girls in classes of 6 and given them lessons in planting, cutting, and transplanting. These girls will each have a bed in the *Girls' Garden*—where she will cultivate her seedlings and sell her fruit and vegetables to the Teacher's Home, thus gaining some pocket money.

This is a new scheme and it is hoped will solve the question of making the girls' garden a success as well as a lesson for the girls.

In summing up our 2d division of labor, we find we have 11 departments employing an average of 153 students; that in these shops while the student does earn a part, or the whole of his living according to the time devoted, yet the chief purpose is to learn a trade and in every one of these ten departments a useful and profitable training is given the hand and head.

It is on this branch of our industries that Mr. Warren's criticism bears when he says that he cannot reconcile the idea of education and manufacture.

If you take the modern idea of a manufactory where division of labor to secure the biggest possible profit is the plan and aim, it cannot be reconciled with education because such manufacturing dwarfs the whole man. But Hampton carries on manufactures for their educational, not their productive, value. When it is a question between the profit of the shop and the educational good of the student, the profit must suffer.

We have spoken before of the Hampton theory that a productive labor is one of the great educational factors for these races, and that the industrial education is not hurt in this combination seems to be conclusively proved not alone by the hundreds of good mechanics that go from here South and West but by the numbers that have taken charge of shops in schools and in other ways showed themselves master workmen.

If, however, Mr. Warren feels that we can not make the money that we ought to with this endowment of shops it can only be said that in putting the goods into market, Hampton does not expect to become independently wealthy. The plant for her industries has been given her and her aim in productive labor is to run her shops on a good thrifty business basis.

We shall never be tempted to hope for great business profits, because as soon as a man is, in a business sense, profitable to the School, he is sent off to teach others.

Quite opposed to this criticism too, is the feeling in many shops that the education of the student is a good investment for the shop; that the more care and thought that is put on the relation of the student to his work the better the business standing of the shop is. Industrial training can be given and productive labor carried on according to the old idea of a small sure business and a well rounded and complete workman but not according to the 19th Century notion of big profits and division of labor.

TECHNICAL EDUCATION.

The third division of the Hampton industries is the group of those which are given for education only.

This includes all the house work and domestic training given the Indian girls and all the classes in cooking, use of tools and agriculture given to the Normal School students.

The Winona Household Department.—As the Government appropriation meets the expenses of board and clothing [leaving tuition to be raised by scholarship] of the Indians while here, there is no need that they should work with an idea of support. The whole aim is to make all their work educational.

Each girl must do her own washing, ironing, dressmaking, mending and take care of her own room. For this she receives no pay. Besides this, all the corridors, teachers' rooms and public rooms of Winona are cared for by the girls for a small sum of money. In this way it is arranged that each girl has a little of all kinds of work, that they take the complete care of their school-home and earn some pocket money by way of encouragement.

In fact, as far as possible, she is given the many sided training that a daughter should have in her home to prepare her for life.

To see a little more carefully how this system is worked out let us look at the different departments.

In the laundry Miss Booth has the 42 girls divided into squads of ten for Mondays' washing; each squad has the use of the laundry for an hour and a half. On their work days they iron their clothes, after which the clothes are inspected in the sewing room and each girl mends her own. Beside this mending they make their own clothes, four cotton dresses a year at the least, prepare extra clothes for the storeroom ready to fit out new students and make and mend all the Wigwam and Winona bedding.

As Winona has no separate kitchen they could not cook their own meals. However there is a small overflow dining room at Winona which they take care of, getting practice in care of table and dishes.

To gain the much needed knowledge of cooking, a small three-roomed cottage on the grounds has been fitted up like a home, with parlor, dining room, kitchen and storeroom. The girls are divided into companies of four and each four uses the cottage for a week. They are given 50 cts. and flour and milk and out of this must get four suppers for themselves and a teacher.

The object kept in view is how to do well with a little. They rarely make cake but learn how to prepare eggs, potatoes, etc., in all ways.

This is meant to be the practical application of the regular cooking lessons, under Miss Williamson. The girls enjoy this as "playing house" on a grand scale. At the end of the year each girl will have had 3 weeks of this training. The money for this unique training school has all been given by charity.

Now that we have seen how the Indian girl learns in laundry, housework, sewing and cooking—let us see what is done for the boy.

Like every student on the ground he has to care for his own room; then turning to the shops, we see many fields of labor before him.

Those now called the "Training Shops" i. e. the Harness Shop, Paint Shop, Shoe Shop and Tin Shop—were at first called the *Indian Training Shops*, and established largely with the idea of giving the Indians practical knowledge of different trades. They have changed their name since then in order to express the fact that they are not limited to one race, but we shall find 21 Indians taking their trades in them and still others in the printing office, machine shop, etc.

The Technical Shop, under the charge of Mr. F. L. Small, manager, is designed to give the training in use of tools and wood turning. Here at present, there are 14 Indian boys, 9 working half of each day and 5 two days per week, under the direct supervision of Mr. Spinney, a colored ex-student. It is intended that every Indian boy shall have nine months. Although the object is purely educational—the work of the students, in the shape of carved paper cutters, inkstands, picture frames, etc., is sold.

In this shop also are given the lessons in free-hand and mechanical drawing to the trades boys.

There are five classes of 8 each from the carpenter shops and one of 14 from the blacksmith and machine shops.

The Abby May Home, under the charge of Miss Austen, has been opened for the first time this year. In this charming building, which truly deserves the name of home ten colored girls at a time are taken for a three months' course. These girls learn to cook, wash, iron, mend and do general housework on a small home scale that they may have a true model after which to fashion their own home. They work all day and go to Night school. Perhaps the greatest lessons they receive here are in their little Saturday night companies, readings with the house-mother, &c.

This life is to give the special training that the size of our school household will not allow in other places. Under the care of this house is brought the cooking and sewing classes and the Girls' Holly Tree Inn.

While the students in the Normal School only work two days in the week instead of six, still here the opportunity is taken to give them in classes technical training

that every person ought to have, as *The Technical Classes* in the use of tools under Miss Katharine Parke. Here all the girls of the Middle Class come for two hours per week for half a year and the Indian School girls for one hour per week for the whole year. They are here taught how to use tools and the principles of construction. Their first work is making a box—as this is meant to help them, both Indian and colored, to make their own homes comfortable, they are taught how they can make the most of things—how to use leather for hinges, how to cover a box, &c. They learn how to make screens, stools, picture frames and how to varnish and paint them. Nothing is sold from this shop, the student keeping what she makes as a reward of her industry.

Again, a colored girl might come into our day school and graduate and not know how to mend her clothes if she had not worked in the industrial rooms. To overcome this the Middlers go one evening in the week to the Abby May Home to a sewing class. This is just to teach plain, neat, old fashioned sewing.

For some years cooking classes have been established. These are now carried on at the Abby May Home.

Here the Middlers go in classes twice a week for half a year. There are ten girls in a class and each class has a thorough course in making fires, baking, boiling, frying, broiling, mixing, seasoning, etc., also in getting up a whole meal, clearing up, &c. The classes give a bread party to which the boys are invited as tasters, and prizes awarded for the finest bread, rolls, &c.

It seems best that every boy that comes to this school both from the West and South should know something about farming. To this end many among the work students are put on the farm—and among our Normal students this year regular classes in agriculture have been established under the charge of Mr. Goodrich and Mr. West.

All the Middle boys attend these one hour a week during the school year.

The adding to and enlarging of this division of the industrial training has been one of the chief aims of this year. Not only have new classes in technical training, as the middle year sewing and agriculture classes been added, but careful thought has been put on the grading and systematizing the work in the shape that all the work may push toward the same end, a complete, well-grounded industrial education.

The attempt in the above has been to only give a quick view of the branches of industry at Hampton, to show somewhat how they have grown up out of both theory and necessity and some of the questions and problems presented by them. Much more copious reports have been made on all their work, which the School will gladly furnish, together with opportunities to see every industry on the grounds to any one who desires to go more deeply into the subject.

ANNIE BEECHER SCOVILLE,
Teacher.

The total attendance of students for 1893, is given as 689. For details see letter of Principal in note.* In the report to the Trus-

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*HAMPTON NORMAL AND AGRICULTURAL INSTITUTE,
Hampton, Va., April 23, '94.

HON. I. EDWARDS CLARKE,
Bureau of Education, Washington, D. C.

DEAR SIR: In reply to your letter of the 17th inst. in regard to the number of students at this school for the year ending June 30th, 1893, I beg to append the following statement of the enrollment for that year:

tees the attendance in the "Whittier School" is given as 265; 136 girls and 129 boys.

The Faculty numbers 80 Professors, Instructors, etc.—20 men and 60 women. Rev. H. B. Frissell, Principal.

THE WEST VIRGINIA UNIVERSITY, MORGANTOWN, WEST VIRGINIA.

The West Virginia Agricultural College was established by the Legislature in accordance with the United States Land Grant Law. The citizens of Morgantown, donating buildings, grounds and money to the amount of $50,000; the college was established there, in 1867. The fund from the proceeds of the United States Land Grant, then amounting, with accrued interest, to $90,000. This endowment was subsequently increased by the State to the sum of $110,000. In addition annual appropriations for current expenses and for additional buildings, have been made. The college grounds consist of 25 acres contiguous to the town of Morgantown, which is on the Monongahela River, Monongahela County. Daily stages connect with Fairmount, a station on the Baltimore and Ohio Railroad.

The name of the college was, on the recommendation of the Governor, changed by the Legislature from that of the "Agricultural College," to its present name the second year after its establishment.

The University now comprises a preparatory Department; The

NORMAL SCHOOL.

	Col'd Girls.	Col'd Boys.	Ind. Girls.	Ind. Boys.
Senior	16	19	0	2
Middle	46	28	8	11
Junior	49	50	8	21
Intermediate	18	20	0	0
	129	117	16	34
Night School,	83	222	0	0
Indian School	0	0	29	59
	212	339	45	93

Total Colored Girls	212
" " Boys	339
" Indian Girls	45
" " Boys	93
	689

The Whittier School, whose census is recorded in our report to the Trustees of this school, while being largely under the control of our Faculty is a public school and consequently we do not reckon its numbers in our returns to your Bureau.

There are frequently small discrepancies between the two reports mentioned from the fact that the annual report is usually put in print in April to be ready for the Annual Meeting of the Trustees in May, while that to the Education Bureau is made June 30th.

Very respectfully,

H. B. FRISSELL, *Principal.*
By F. C. BRIGGS.

College, with both a classical and a scientific Department with courses of four years; and a Department of Engineering, of which the course for the first three years is the same as the "Scientific" course, the studies of Senior year alone varying. "Civil Engineering—Mahan," "Military Engineering—Mahan," and "Gillespie on Location, construction and improvement of Roads and Railroads," are studied; each one term.—A Military Department, in which there is instruction in Military Science running through four years, and an Agricultural Department, with a two years course. There are also "Law" and "Medical" Departments. Drawing does not any where appear in the schedule of studies, except as Map Drawing in two terms of the first year.

The catalogue for 1879–'80, shows a total of 132 students in all the departments; 52, in the college proper, and 70, in the preparatory Department.

LATER HISTORY.

The latest "Biennial Report of the Board of Regents," dated December 10th, 1892, shows a marked increase in the number of students over the total as given in the catalogue of 1879–'80. "For the year ending June, 1891, the total was 205; and for the year ending June, 1892, it was 224." The lack of an adequate number of high schools and academies, in the State, fitted to prepare pupils for entrance into college, is noted as a persistent hindrance to the growth of the University. Many who desire a college training, being compelled to leave their homes in order to attend the preparatory course of two years, in the University, before being qualified to pass the entrance examination for the Academical Department; in frequent instances thereby so exhausting their pecuniary resources as to be unable to continue.

The additional income, under "the new Morrill Act of 1890," has enabled the college to open two new courses of study; one, of three years, in Agriculture, leading to the Degree of Bachelor of Agriculture, and one of four years, in Mechanical Engineering; leading to the Degree of Bachelor of Science in Mechanical Engineering.

A building for the Department of Mechanic Arts and Mechanical Engineering, authorized by the Legislature at its last session, has been completed at a cost of $5,000.00, appropriated by the Legislature, and equipped at a cost of $12,000, at the expense of the Morrill Fund.

Professor Emory, a graduate of Worcester (Mass.) Polytechnic University, has been appointed Professor in the new Department of Mechanical Engineering.

The Legislature, also, authorized the erection of another building to be known as Science Hall, at a cost not to exceed $40,000, which has been begun. An appeal is also made to the Legislature for an additional building; to be used for instruction in Electrical Engineering, the plant of which is to be provided from the Morrill Fund.

The latest catalogue* at hand, that for 1892–'93, contains an interesting table giving a "comparative view of courses for Bachelor Degrees," of which five are offered, viz: A. B., B. S., B. S. C. E., B. S. M. E., and B. AGR. The frontispiece gives views of the five most important buildings.

The Legislature designated the University to receive all the residue of the Fund arising from the new U. S. Land Grant of '90, after the due proportion assigned by that law, has been given to the "West Virginia Colored Institute," an institution for the instruction of colored youth in Agricultural and Mechanical Science, recently established in the county of Kanawha, by the Legislature, in accordance with the provisions of the U. S. Law. Three thousand dollars per annum for five years; and, after that, five thousand dollars a year, being assigned to that Institute.

The stimulating impulse given by this addition to the U. S. Grant Fund, is a very marked feature in the recent history of all the Land Grant Colleges; as has also been the case where the new Agricultural Experiment Stations have been attached to an existing institution. By these two laws, Congress has wisely made possible the much needed development of the Scientific Departments for the training of students; and, also, given to the community, the opportunity to avail themselves of the best and latest results of scientific investigation; which is ever progressive.

INSTRUCTION IN DRAWING.

In the course of Civil Engineering; Drawing, in its several branches of Freehand, Mechanical, and Instrumental, is taught throughout the course. In the course in Mechanical Engineering; Mechanical Drawing is taken for a single term in the second year, and through all the third year. "Shopwork" is also taken up throughout the third year. In the "Mechanic Arts" there are courses in Woodworking; Moulding and Casting; Forging; Tin Smithing; Pipe Fitting; Machine Shop work; and Machine Construction. All students in the Agricultural course are required to take a course in manual training sufficient to give a practical knowledge of working in wood and iron. The building containing the shops, a substantial structure 90 x 38 feet, is ample in size and fully equipped with requisite tools and machinery for use of the students taking the three years course in Mechanic Arts. This course is open to all the students. A special course in Mechanic Arts of one year, is provided for the students in Agriculture. The estimated necessary living expenses of students for the Academic year of thirty six weeks are given as ranging between the limits of $137.00, and $204.00. This

*Catalogue of West Virginia University, Morgantown. For the year 1892–'93. Charleston, W. Va. Moses W. Donnally Public Printer. 1893. Ill. Pp. 106.

includes all expenses except tuition fees. These are $12.50 a term for students in the University from other States; and $5.00 a term for such students in the Preparatory Department. Tuition is free to citizens of West Virginia, except in the Law School. The Collegiate Department of the University is equally open to youth of both sexes. A very small number of girls, however, are in attendance.

It will be observed that Drawing is given only in its relation to engineering and mechanics. There is no instruction in Drawing in its relation to the Fine Arts. The Military Department of the University is fully developed. Cadets are appointed by law, from the General Assembly Represenative and Senatorial districts of the State.

The total number of students in attendance for the year 1892–'93 is given at 231, with 3 deducted as counted twice. Of these 108 are Preparatory, 22 Law, and 101 Collegiate. It may be of interest to give the distribution of these Academical students and to note how few here, as elsewhere, seek degrees in Agriculture.

For degree of A. B. 33, B. S. 17, C. & M. Enging. 4, B. AGR. 2. Special students in some of these Departments, not studying for a degree, 34. "The Faculty and Teachers" number 20. E. M. Turner, LL. D., President.

The University of Wisconsin, Madison, Wisconsin.

The State University was chartered in 1848, and organized and opened for students in 1849. The Agricultural College was organized in 1866.

"The University Fund" consisted of the proceeds of the sales of land granted by acts of Congress for the support of the University, approved June 12, 1838, August 6, 1846, and December 12, 1854. The available fund amounted in 1881, to $226,796.86.

The Agricultural College Fund consists of the proceeds of the sales of 240,000 acres of land granted by act of Congress, approved July 2, 1862.

The amount of the productive Agricultural fund was in 1881, $271,939.81. Some portion of the lands accruing under the grants both to the University Fund, and to the Agricultural Fund, still remain unsold. The above statements are from the annual Report of the Secretary of the Board of Regents of the University, under date of October 1st, 1881.

It will be seen that this institution is the outcome of, and in itself illustrates, the continuous policy of direct encouragement and assistance to higher education, adopted by the Congress of the United States. With the material progress of the country, the rapid development of science, and the ever growing activities of the Industrial Arts, the expansion of the needs of higher education have been recog-

nized by Congress. It will be noted that the Agricultural Fund created to meet the new needs, is somewhat in excess of the fund arising from the previous grants; made before the needs of the industrial classes for higher technical training had been recognized.

Few institutions so well illustrate the continuous policy of the United States government in aid and encouragement of education, as, in many cases, in other States, the funds created by different grants have been distributed among different institutions. Here the development of the new education and the proof of its recognition by the government of the United States, are clearly shown.

In accordance with the provisions of the United States law of 1862, the University was re-organized in 1866, as appears by the following extracts from the laws of the State.

REORGANIZATION.

Chapter 144, General Laws of 1866.

Section 1. The object of the University of Wisconsin shall be to provide the means of acquiring a thorough knowledge of the various branches of learning connected with scientific, industrial, and professional pursuits; and to this end it shall consist of the following colleges, to wit: 1st. The College of Arts; 2d. The College of Letters; 3d. Such professional, and other colleges, as from time to time may be added thereto or connected therewith.

Section 2. The College of Arts shall embrace courses of instruction in the mathematical, physical, and natural sciences, with their application to the industrial arts, such as agriculture, mechanics and engineering, mining and metallurgy, manufactures, architecture, and commerce; in such branches included in the College of Letters as shall be necessary to a proper fitting of the pupils in the scientific and practical courses for their chosen pursuits; and in military tactics; and as soon as the income of the University shall allow, in such order as the wants of the public shall seem to require, the said courses in the sciences, and their application to the practical arts, shall be expanded into distinct colleges of the University, each with its own faculty and appropriate title.

Section 3. The College of Letters shall be co-existent with the College of Arts, and shall embrace a liberal course of instruction in languages, literature, and philosophy, together with such courses, or parts of courses, in the College of Arts, as the authorities of the University shall prescribe.

Amendment of 1867.

Section 1. The University shall be open to female as well as male students, under such regulations as the Board of Regents may deem proper; and all able-bodied male students of the University, in whatever college, shall receive instruction and discipline in military tactics; the requisite arms for which shall be furnished by the State.

The following extract from the report of the "Board of Visitors," to the "Board of Regents," made June 21st, 1881; gives a view of the University as then organized, and of the provisions made to carry out the purposes of the United States Grant of 1862:

The University seems to be well balanced in the several departments of study and experiment, and your committee begs leave to commend the institution to the continued favorable attention of the citizens of the State as an efficient means whereby young men and women can prepare for the activities of life.

In the ancient and modern classical courses, the work, as far as we witnessed in

visiting the class rooms, showed in the main careful preparation. The English course and the applied sciences are efficiently administered, bringing the student into vital contact with the history of literature, of the race, and of the past and present literature itself, and the truths of natural science, and inspiring students with the great practical utilities of the industrial world.

Citizens and professionals alike see in the materials of the University farm and shops most potent means of instruction, stimulating for young men and women the same thought, except in degree, that the kindergarten purposes for the child, and with the sole end of suggesting the parallelism of art to science, of practice to theory; and the committee observes further, that the advantages which the agricultural and mechanical departments are designed to confer should not be lightly esteemed. The vast importance of the branches should receive your liberal attention. The present prosperity and future greatness of our state depends largely upon her agricultural productions and manufacturing interests.

By act of Congress of 1862, there were donated to the several states certain lands for the establishment of colleges for the benefit of the agricultural and mechanic arts. The revenues from the funds arising from the sale of such lands are by the terms of the act to be applied to the purposes indicated. We find that a special effort has been made by the erection of the new science building, the purchase and maintenance of a university farm, the establishment of a professorship and liberal equipment of laboratories and machine shops, to carry out the spirit and intent of this law. These features of the University we cannot too highly commend. In special training of young men as engineers, miners, chemists, geologists, machinists, farmers and draughtsmen, the University offers inducements equal to the best special schools in the country. This is not, perhaps, as well understood in the state as it ought to be. We think a special effort should be made by circulars liberally distributed, or other proper means, to bring these facts before the people of the state.

The following passage from the Report of President Bascom to the Regents,* is interesting as showing the tendency towards adjustment between the different courses of training offered:

There has been for the past half-dozen years, a steady alteration in the relative number of students pursuing the three leading courses of study: the Ancient Classical, the Modern Classical and the Scientific. In 1875 the number in the University belonging to the Ancient Classical Course was thirty-nine; to the Modern Classical, twenty-six, and to the Scientific Course one hundred and twenty. In the year which has just closed, the respective numbers are sixty, seventy-one and seventy-six. The number in the three departments are becoming nearly equal. This fact seems to be due to a variety of influences: (1) The terms of admission in the Scientific Course have been somewhat enlarged. (2) Young women are preferring the Modern Classical Course. (3) The strong feeling in favor of a scientific education as opposed to a classical one seems to be somewhat abated.

An experimental farm is attached to the Agricultural College. The report of the Professor of Agriculture on the results obtained during the year, occupies nearly 50 pages of the Report of the Board of Regents for 1881.

A well equipped astronomical observatory, the gift of the late Ex-Governor Washburn, is also attached to the University, which thus possesses two of the most important facilities for training in Science and Agriculture.

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*See page 25 of Annual Report of the Board of Regents of the University of Wisconsin for the fiscal year ending September 30th, 1881. Pp. 86.

The College of Arts embraces a General Science Course, and the Special Technical Departments of Agriculture, Civil Engineering, Mining Engineering and Metallurgy, and Mechanical Engineering.

It will be seen by the following paragraphs from the catalogue of 1881–'82, that the importance of the study of drawing, in all the engineering and industrial courses, is fully recognized.

Draughting.—Instruction in draughting commences with the course of special study in the Sophomore year, and is continued in daily exercises of two hours each, throughout the course, with the exception of one term in the Junior year and such days as are taken for field practice, in the one course, and shop-practice, in the other. The students are first taught the use of draughting instruments, and the simpler draughting operations. The principles of descriptive geometry, taught in the class room, are then further illustrated and enforced by a progressive series of special problems, including projections and intersections of lines, surfaces, and solids; and problems in shades, shadows, perspective and isometric projection, which the students are required to solve, and carefully and exactly execute. These are followed, in due order, by instruction in shading and tinting with pen and brush, in India ink and water colors.

The students in civil engineering receive special instruction in the preparation of detailed drawings for masonry structures, in the delineation of topography by pen and in colors, and in the plotting of land, railroad and topographical, surveys from the field notes. They are also required to make finished and detailed drawings of a variety of structures and apparatus.

Students in mechanical engineering are instructed in sketching and making working and finished drawings of machines. A large number of drawings is required, and the subjects are chosen almost exclusively from actual constructions. The principles of design are taught, and the students required to show his proficiency by making one or more original designs.

In the Department of Agriculture the design of which, as stated in the catalogue, "is to give a thorough and extensive course of scientific instruction, in which the leading studies shall be those that relate to Agriculture" Machine shop practice is given the first two terms of the Freshman year. "Freehand Drawing," the first term, and "Agricultural Drawing," the second term, of Sophomore year. "Topographical Drawing," the second term of Junior year, and "Æsthetics" and "Landscape Gardening," the third term of Senior year. In the special Agricultural course of two years "Free Hand Drawing," is taught first term, and "Shop practice and use of tools," second term, of first year.

In Civil Engineering, the first year, the studies are the same as in the general scientific course with the exception, that, if desired, "French," may be taken instead of "Anglo Saxon." "Free hand and geometrical Drawing," are taught first term, "Map Projection and Stereotomy Problems," the second term, and Stereotomy Problems and "Plotting" the third term, of Sophomore year. "Topographical" first term, "Drawing" second term, and "Drawing—Steam Boilers and Engines," third term, of Junior year. "Bridges and Roofs," first term, "Hydraulic Machinery" second term, and "Preparation of Thesis Drawing" third term, of Senior year.

In Mining Engineering, the studies of the first years are the same as in Civil Engineering. "Topographical" Drawing first term, "Drawing" second term, and "Furnaces, etc." third term, of Junior year. "Drawing" each term of Senior year.

PRACTICAL MECHANICS.—Mr. King.—

The course in mechanical engineering was established in 1877, and with it was commenced, as a prime requisite, the fitting up of a proper machine shop, wherein instruction in practical mechanics and machine construction, might be given, in connection with that in the class room.

The shop is a large, well-lighted room, 38 by 40 feet, 14 feet high, in the basement of Science Hall. The equipment of machinery and tools is all after the latest and most approved practice, and consists of a Sellers planer, three engine lathes, a hand lathe, a Brown & Sharp's milling machine, and a Fitchburg upright drill, with conveniently-placed and arranged work benches, vices, etc., and a large collection of taps, dies, twist drills, fluted reamers, etc. It has also received and put in place, a Stowe flexible shaft and attachment, the gift of Mr. George W. Burnham, of Philadelphia. The motive power is furnished by a fine 30-horse power, Crane Bros. steam engine.

Ten hours' work is required each week throughout the course. The method of instruction is modelled after the Russian system, and that of the Worcester, Mass., Institute of Industrial Science. * * *

It is also designed to construct, as fast as possible, working models of machinery for the purpose of instruction, and each student, before graduating, will be required to design and construct one or more of these models.

In Mechanical Engineering, "Freehand and Mechanical Drawing," first term, "Elementary Mechanical," second term, and "Mechanical" third term, of Sophomore year; "Shop work" and "Drawing" the three terms of Junior Year; "Steam Engine," "Shopwork and Drawing," and "Preparations of Drawing to accompany Thesis," fill out the three terms of Senior year.

In the Autumn of 1881, there were 345 students in college studies, 91 of these were in the various scientific and industrial courses. There was a grand total of 401 students in all departments of the University; of these 101 were young ladies.

LATER HISTORY.

In their Biennial Report for the two years ending September 30th, 1890,* the latest at hand, the Board of Regents, while noting the satisfactory growth of the University since their last report, draw a sharp contrast between the necessary expenses for instruction incurred by the higher educational institutions twenty years ago, and at the present time.

When only languages, literature, mathematics and natural history were taught in the University, the apparatus and appliances for giving instruction were comparatively inexpensive. Twenty years ago one theodolite chain and staff answered

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* Fourth Biennial Report of the Board of Regents of the University of Wisconsin for the School Years 1888–'9, 1889–'90. Madison, Wisconsin: Democrat Printing Company, State Printers. 1890. Pp. 55.

all the requirements of the civil engineering department, while the departments of mechanical and electrical engineering and that of agriculture were even less expensively equipped. The demands made on the University are very different now! * * * Many thousands of dollars of the income of the University, for the past two years, have gone into machines, apparatus, appliances and material for giving, to the best advantage, the instruction demanded by the times, and many thousands of dollars must yet be expended in this way.

The report by the President of the University to the Board of Regents for the same period, contains very interesting analytical tables of statistics showing the annual growth of the University from 1885–'86, to 1889–'90, by the total numbers in attendance, and also, by colleges, by courses, and by collegiate departments as compared with Professional departments. In total attendance, there were 443, in 1885,–'86, and 790, in 1889–'90. The college of Letters and Science, had 217, in 1886–'87, and 306, in 1889–'90. The College of Mechanics and Engineering, had 43, in 1886–'87, and 113, in 1889–'90. The College of Agriculture, had 26, in 1886–'87, and 32, in 1889–'90. College of Law 70, in 1886–'87 and 112, in 1889–'90. School of Pharmacy, 16, in 1886–'87, and 35, in 1889–'90. The growth by "courses," is shown by details of fourteen courses. Of these, Civil Engineering, shows 17, in 1886–'87, and 27, in 1889–'90; Mechanical Engineering, 25, the first of the above years and 43, the last; Electrical Engineering, appears for the first time in 1889–'90, with 9 students; Metallurgical and mining had 2, the first, and 3, the last year. The Collegiate Departments had 342, the first, and 483, the last, of those years, and Professional Departments, had 168, and 265 students, the corresponding years. The Humanity courses, in contrast with the Physical Science course, show, for the same years, as follows: Humanity, 166, in 1886–'87, and 314, in 1889–'90; The Science course, 51, in 1886–'87, and 68, in 1889–'90. These statistics are extended in great detail; the single exercises given in 33 studies, are stated for four years, for each of the three terms of the scholastic year. For the two-year spaces, beginning in 1886 and ending in 1890, the Language and Literature courses, increased about two per cent, and the Natural Science courses, fell off about three per cent: Mathematics however increased about one per cent; and History, Civics, and Philosophy, about held their own—which is nearly 7 per cent of the whole, where Language and Literature had about 40; Natural Science ab't 25; and Mathematics about 15, per cent. "The University offers 246 sub courses of study." Twelve of these are in Practical Mechanics; ten, in Theoretical Mechanics; ten, in draughting; three, in topographical engineering; sixteen, in special engineering; and ten in Agriculture. The President closes a very minute enumeration of the different courses, sub courses, and studies, with the following statement:

The foregoing facts have been given thus fully and specifically because of a supposed tendency to over-growth in the direction of the physical sciences. The facts

do not appear to me to support this, but the ample data given enable every one to draw his own conclusions. To my interpretation the facts pointedly indicate a natural, wholesome, and reasonably symmetrical growth.

The enlargement in the departments of Agriculture, and the Mechanic Arts, made possible by the passage of the U. S. law of 1890, increasing the former Land Grant Fund by an annual increment, is recorded; an additional course in Agriculture is established, and courses in Electrical and Railway Engineering, have been opened.

The report of the Board of Visitors made at the same time, shows a hearty appreciation of the needs of the Science and Engineering departments. They recommend a special appropriation to defray the expenses of a Professor of the University on a tour of investigation among Technological Schools; and, also, to visit the Manufacturing Establishments connected with the branches taught. They say:

We believe that such visits, with a proper report made to the Board of Regents, would be productive of much good, in that it would give to both instructors and pupils the benefits of the rapid advances being made in the Mechanical Arts.

From the latest catalogue* at hand, the following statements, showing something of the present status of the University, are compiled.

LOCATION.

The University of Wisconsin is situated at Madison the capital of the State of Wisconsin. The University grounds comprise 240 acres and extend for more than a mile along the south shore of Lake Mendota, a sheet of water about five miles in width and six miles in length. University hill occupies the eastern part of the grounds. It rises abruptly from the lake and has two summits, of which the eastern and higher reaches a height of about one hundred feet from the lake. Most of the college buildings are placed on the summit and eastern slope of this hill. * * * The legislature in 1893, authorized the purchase of an additional tract of contiguous land, 45 acres in extent. * * The buildings of the University which are used for instructional purposes are thirteen in number.

GENERAL POLICY.

* * * It is the general policy of the institution to foster the higher educational interests of the State, broadly and generously interpreted. It is its aim to make ample provision for the demands of advanced scholarship in as many lines as its means will permit. * * * The University recognizes no distinction of race, color, or sex.

The University is amply supplied with Libraries, Laboratories and Science Museums with an excellent Astronomical Observatory. Students have access to the State law library, of 25,000 volumes, and, also, to that of the State Historical Society with some 76,000 volumes and 77,000 pamphlets.

*Catalogue of the University of Wisconsin for 1892–1893. Madison, Wis. Published by the University, 1893. Pp. 207.

ORGANIZATION OF THE UNIVERSITY.

The University embraces four "colleges," viz: Letters and Science; Mechanics and Engineering; Agriculture; Law; and two "Schools," viz: Pharmacy; Economics, Political Science, and History. The College of Letters and Science, embraces five regular "Courses," and two "Special Courses," one for proposed students of Medicine, and one for Normal School Graduates; also, "under the Group System, a large number of courses." The College of Mechanics and Engineering, embraces four engineering courses, viz: "Civil," "Mechanical," "Mining and Metallurgical" and "Electrical." The College of Agriculture, embraces four "Courses," also, "the Experiment Station;" and "The Farmers Institutes." The College of Law, embraces two courses; one of two, and one of three years. The School of Pharmacy, has three "courses." "The School of Economics, Political Science, and History, embraces: I. Numerous Undergraduate courses in all these branches. II. Graduate courses, leading to the higher degrees."

In Philosophy, "Æsthetics and the History of Art," are taught five times a week in the fall term, by Professor Stearns. This is the only reference observed to the giving of any art instruction. Drawing, some knowledge of which is absolutely essential to instruction in Engineering and Mechanics, seems confined to the forms directly applicable to those mechanical and instrumental needs. In these the instruction, judging from the time required to be given, seems very thorough. Shop work, required of all the Engineering students, is in charge of a Professor, and four assistants. It comprises twelve courses, viz:

Bench and Machine Work in Wood; Foundry Work; Bench Work in Iron; Production of Flat Surfaces and Straight Edges; Machine Work in Iron; Tool Making; Machine Construction; Forge Work; Practice at the Lathe and Milling Machine; Construction and Pattern Work; Construction; Construction and Testing.

The "Summary of Students" shows a total attendance of 1296—from which 9 are deducted as twice counted, leaving a total of 1287 actual individual students. Of these 92 are Graduates; 711, in College of Letters and Science; 179, in College of Mechanics and Engineering; 175, in College of Agriculture; 166, in College of Law; 65, in School of Pharmacy. Something of a contrast as compared with the total of 401 students, given as in attendance in the year 1881.

The list of "Officers of Instruction and Government" connected with the University numbers 106. Of these, 21 are classed as "special Lecturers;" 7, as "other officers;" and 6, as "Members of the Faculty Elect." This leaves an active teaching and directive force of 72 Professors and Instructors. The "Corps of Instruction" of the College of Mechanics and Engineering numbers 30; not including the President of the University. Of these, 13 are instructors in the

technics of Engineering and Mechanics; and 17 are instructors in general studies, Science, the languages, etc. The Corps of Instruction of the College of Agriculture numbers 29, exclusive of the President of the University. There are, also, 8 officers of the Experiment Station. There are in addition to the regular Academical force, 35 Institute Speakers, who visit and address the Farmers Institutes throughout the State. These institutes are a striking feature of the State system of encouragement to a general dissemination of a knowledge of the Science of Agriculture. W. H. Morrison, is Superintendent. "During 1892–'3, 97 institutes, lasting two days each, were held at the places named." Although this College of Agriculture is a department of the State University, which in some cases has been thought disadvantageous, there seems no possibility of any just criticism of that kind in this instance. Charles Kendall Adams, LL. D., President of the University.

CHAPTER XV.

UNITED STATES LAND GRANT COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS—Concluded.

ANALYSIS OF CHAPTER.

A GROUP OF NEW INSTITUTIONS.

Attention has already been called in these later chapters to the influence in stimulating the growth and developing the activities of the long established colleges of Agriculture and the Mechanic Arts, resulting from the subsequent passage by Congress of the two laws relating to these institutions.

The first of these laws which was passed in 1887, and popularly known as the "Hatch act," from the name of the member who introduced it,—Hon. Wm. H. Hatch, of Missouri, chairman House Committee on Agriculture,—established the Agricultural Experiment Stations with the purpose of serving the interests of the Agricultural Community; while the second, passed in 1890, and popularly known as the supplementary Morrill act, directed an annual additional appropriation to increase the income accruing to the Land Grant Colleges from the Land Grant Law of 1862. As these Agricultural Experiment Stations thus created by the first of these laws and endowed with an annual income of $15,000 each, have generally been placed in close connection with the Agricultural Colleges, the two institutions have been of mutual aid to each other; while the additional income, accruing from the law of 1890, which begins at $15,000 and increases by an annual increment of one thousand dollars till it reaches the sum of $25,000 annually, and which is to be devoted to the employment of additional teaching force and to increasing the material equipment of the institution in the way of

machinery, tools, books, collections, etc., could hardly fail of important results.

It remains briefly to note the farther influence of these recent laws in calling into existence new institutions in the Territories and new States of the Union. As these later colleges have for the most part been established, and opened, or taken their present form, within the past three years; and as they are closely modelled after the older colleges which have been here described, there will be little attempt to do more than to record their names and locations, noting briefly any striking individual peculiarities arising from their surroundings; for it is of interest to see how, in some degree at least, institutions, as well as individuals, take shape and color from their immediate environment. The exigencies of the new settlements, the scattered population, the different languages spoken by the inhabitants, the character of the country, whether plain or mountain, well watered or arid, agricultural or mining; conditions, some of which are found in each of the countries where are situated these new colleges, furnish striking illustrations of such adaptation. It is in these new settlements that the beneficent wisdom of this National legislation in favor of education, is most readily recognized. Carefully guarded so as to stimulate local effort, rather than to substitute outside aid for self help, it enables the young community to secure at once educational facilities and opportunities which otherwise must have been deferred for a generation.

The University of Arizona, Tucson, Arizona.*

The law creating the University was passed by the Territorial Legislature in 1885. The control of the University is given to a Board of Four Regents to be appointed by the Governor. The Secretary of the Territory and the Superintendent of Education are, also, "ex officio," members of the Board. The Regents accepted for the site of the buildings the gift of a tract of forty acres of land on high ground commanding an attractive mountain view, and distant about one mile from the business centre of Tucson. The first building, the "School of Mines" building, begun in 1887, was not, however, completed till 1891. The college was first opened for students October 1st, 1891.

The resources of the institution are derived from an annual tax of about $4,500.00, to pay the interest on Territorial Bonds pledged to the uses of the University, and from the National appropriation under the law of 1890. Besides these two sources of revenue, the conditions of the law establishing Agricultural Stations were also

*The University of Arizona. "Each man must be a unit—must yield the peculiar fruit which he was created to bear." Holmes.—"Come with us and we will do you good." Second Annual Register 1892–3, with announcements for 1893–4. Tucson, Arizona, June 1893. Pp. 104.

complied with in 1889–90, "and at the same time the College of Agriculture was established, the Director of the Experiment Station being made Professor of Agriculture in the University."

The organization of the University contemplates Five Departments or Colleges. Two of these, "Agriculture," and "Mines," were opened at first. The college of Agriculture has two schools; "Agriculture," and "Irrigation." The College of Mines has three schools; "Mines," "Engineering," "Mathematics."

The powerful influence of local needs in shaping the development of the institution is shown by the importance given to the study of "Irrigation," and to the "College of Mines." Students of mining and metallurgy, are offered great facilities; and the Assay Laboratory is fully equipped.

The Colleges of "Natural Science," and of "Letters," have been since opened. There is, also, a Preparatory School, and "Schools of Art;" namely of Music, Painting, and Elocution, as well as "Schools of Business." In all, there are at present fifteen schools established.

The University is "open to all qualified persons of either sex." There is no charge for tuition in any of the Departments of the University except in the Schools of Art and Business, where instructors fees are exacted. The necessary cost to students is estimated at from $170 to $200 per annum; exclusive of clothing.

The School of Industrial Drawing is in the College of Mines. All engineering students are required to give nine or ten hours a week to Industrial Drawing, during Freshman year; the same is required of Agricultural students for two terms of this year. Free Hand Drawing is taught, both as a preparatory and a university study, and is prescribed for most students without fee. Advanced work in Design, and technical Free Hand Drawing, when sought by the student, is subject to charges for instructor's fees. In view of the relative number of students to professors and instructors, and of the variety of courses offered, the Arizona youth seem to have very unusual educational opportunities. The list of students in attendance for 1892–93, gives a total of 38, of whom 12 are girls. There are 13 students in the Preparatory school; 3 special students; 18 in the Freshman class, and 4 in the Sophomore class of the University. The Faculty number eight Professors. There are also four Instructors who are not members of the governing Faculty. Theodore Bryant Comstock, D. S., Professor of Mining and Metallurgy, and Dean of the School of Mines, is the President of the University.

The University of Idaho, Moscow, Idaho.*

The University was founded and located at Moscow, by the Territorial Legislature, by act approved January 30th, 1889. This act was confirmed in the Constitution of the new State adopted November, 1889. A building fund was created by a tax levy. It was not till

*Calendar of the University of Idaho for 1893–1894. Moscow, Idaho, 1893. Pp. 96.

October 3rd, 1892, that the building was ready for occupation. The organic law defined the purpose of the University to be

To provide the means of acquiring a thorough knowledge of the various branches of learning connected with scientific, industrial and professional pursuits, and to this end it shall consist of the following colleges or departments, to wit:

First.—The college or department of Arts.

Second.—The college or department of Letters.

Third.—The professional or other colleges or departments as may from time to time be added thereto or connected therewith.

The provisions in the law, for the creation of other departments as need may arise, are so comprehensive and unrestricted as to include all possible forms of scientific discoveries in their relation to industrial arts; nor are the interests of Literature, Language, or Philosophy, in any way ignored. Provision is made for the equal development of the two main divisions of the University. The "departments" or "colleges," already organized are those of "Arts;" "Letters;" "Agriculture." "The institution is co-educational."

The City of Moscow, a town of five thousand inhabitants, is described as

"One of the most beautiful in the famous Palouse country." It is on the main line of the Spokane and Palouse Railroad—Northern Pacific—and on a branch of the Pendleton and Spokane railroad—Union Pacific. * * The altitude is about 2600 feet, the air is pure and invigorating; and the climate healthful. * * *

UNIVERSITY SITE.

The University is located upon one of the beautiful rolling hills that environ the city of Moscow. The view from the University is one of varied and surprising features and is easily one of the most inspiring in the northwest. To the north lie the Moscow mountains, a range of beautifully wooded foothills that project from the Cœur d'Alene range with Kamiac Butte to the northwest, a lone sentinel to mark the boundary line between Idaho and Washington; far eastward are to be seen the foothills of the Bitter Root range, while in the foreground the eye falls upon the Paradise hills, with their scattered evergreens and patches of prairie. The Campus comprises twenty acres.

The building is an imposing brick structure, commodious, and well adapted to the purpose for which intended.

It is 180 feet long and the greatest width is 122 feet; including the basement it is four stories in height. When completed there will be about forty-five bright, cheerful rooms, each suitable for school purposes.

The interior finish is California red-wood, giving a rich and attractive effect.

It is by far the largest, the most substantial, and the most attractive building in Idaho.

Five "Courses of Instruction," have been organized; these are "The Classical;" "Scientific;" "Mechanic Arts and Engineering;" "Agricultural;" and "English;" Each of four years. There is also a "Preparatory Course" of three years. Among the requisites for admission to the Freshman class of the collegiate courses Free Hand drawing is included. In the "Classical Course," Drawing does not appear. In the "Scientific Course" it is a required study for the first two terms of Freshman year. In the "Engineering Course," it

appears in some form through all the four years. In the "Agricultural," it is required one term in the first two years, and the same in the "English" course. Instruction in Architecture, is given during Senior year in the course in "Engineering." Drawing, both "Free Hand" and "Industrial," is required of all students in the Institution. When the main building is completed the basement will be available for Mechanical Laboratories and Shops.

In this institution unusual attention seems to be given to the Preparatory School, the full course of which is three years; and especial emphasis is given to the importance and value of a thorough knowledge of the language and literature of our mother tongue. There is, also, a sub Preparatory Class. As these features of fitting schools are largely due to the peculiar conditions and scattered population of the Mountain State, the pages of the Register given to these Preparatory Classes are quoted from at unusual length. It is very interesting to note the attention given to the literature of our noble English language in these primary departments, as is shown by the list of authors required for admission to this school. It is surely a worthy purpose to endeavor to give a love of the best reading when teaching how to read.

PREPARATORY SCHOOL.

The Preparatory School is sustained expressly for preparing students for the college courses. While a high standard of excellence is maintained the preparatory course is so arranged as to facilitate preparation for college. No instruction is given in the elementary sciences, except in physical geography and physiology, as the sciences are fully treated in the collegiate department. Accordingly students devote their entire time in the preparatory course to those branches that lead directly to the college courses.

The Preparatory School is under the immediate supervision of the President and the Faculty. Many of the classes recite to the regular college professors. This insures a high order of instruction and thoroughly harmonizes the methods of the fitting school with those of the University proper.

No student teachers are employed, except in short-hand, typewriting and penmanship.

While the course, as stated above, is strictly college preparatory, it is, nevertheless, a thoroughly practical course, being divested of non-essentials, and invaluable to those who do not contemplate entering upon the University courses.

* * * * * * *

DRAWING.

Special Requirements: Drawing is required throughout the course. Students entering any year but the Sub-Preparatory will be required to make up the drawing under the direction of the instructor in that branch. Students must write a fair hand. No student will be admitted to an advanced class whose composition work is defective and whose spelling and penmanship are poor, until such deficiencies are removed.

REMARKS.

An experience of many years in school work convinces the writer that students are invariably weak in English grammar, composition and literature. This may be due to defective courses, or to unproductive methods of instruction. It may be due to a lack of appreciation of the value of the study of our language as a means of mental discipline, to a lack of its importance as an element of liberal culture.

An indifference to correct pronunciation and spelling, and to the grammatical use of language is too prevalent even among well informed people.

The Preparatory Course of the University of Idaho is made particularly strong in its attention to English. Aside from the disciplinary and culture value of a critical study of English—too commonly underestimated—there are two reasons why this branch of learning is magnified. First, to induce pride and accuracy in the use of our language; second, so to qualify students that they will be able to interpret the thought found in the rules, definitions and discussions in their subsequent studies.

With these values in view, grammar and literature are separate branches during the first year preparatory.

In the second year, grammar and literature constitute the unit of study, while literature and history constitute a unit of work in the senior preparatory. To those not taking Latin a full and invigorating course in English will be offered.

Let it not be overlooked that English is a vital element in the preparatory course of this institution.

COURSE IN LITERATURE

Upon which students will be examined for admission to the several classes, Sept., 1894.

To enter First Year: Hawthorne's Wonder Book, Tales of the White Hills; Kingsley's Greek Heroes; Johonnot's Historical and Natural History Series.

To enter Second Year: Hawthorne's Biographical Stories; Scott's Ivanhoe; Tales of a Grandfather; Cooper's Spy; Tom Brown at Rugby.

To enter Third Year: Scott's Lady of the Lake; David Copperfield; Vicar of Wakefield; Holland's Bitter Sweet, Arthur Bonnicastle; Lincoln's Gettysburgh Speech.

To enter Freshman: Dickens's Child's History of England; Whittier's Snow Bound; Goldsmith's Deserted Village; Shakespeare's Julius Cæsar.

SUB-PREPARATORY CLASS.

It has been found necessary to form a class of lower grade than the first year preparatory, which is known as the Sub-Preparatory. The formation of this class is due to the large number of young people who live in sparsely settled districts where school is maintained but a few weeks of each year.

A teacher of unusual skill and power is assigned to this class, devoting her entire time and attention to students unable to enter at first upon the regular preparatory work. To join this class the applicant should be 14 years of age, and show both inclination and ability to do the work required. Parents at a distance are advised not to send young sons and daughters expecting that the Faculty can assume a guardianship over them out of school.

Every effort will be made to secure suitable boarding places, to take a kind and friendly interest in the welfare of each, to advise each as to the proper use of time and money, and in a general way to look after the moral welfare of each student out of school. But no direct or immediate responsibility can be assumed, as the institution has no dormitory.

TO YOUNG LADIES AND GENTLEMEN.—(PERSONAL.)

You must first make up your mind that your duty to yourself as an individual and as a citizen of the commonwealth requires of you the best education it is possible for you to acquire. You must remember that tuition in the State University is free. It matters not how poor your scholarship, or "backward" in your studies as it is often expressed, the University is for you. If you fear you cannot pass the entrance examination, there is still another way to enter the Preparatory School. You may join the Sub-Preparatory class where every advantage will be given you to get started in your studies and accustomed to school life. This class will be so

conducted that the moment you are able to do stronger work that fact will be found out and you will be advanced. It matters not how plainly you are clad, how poor your scholarship, the University offers you its benefits. If you are determined to learn, if you will make the effort and the sacrifice, a liberal education is possible.

In the pages given to the announcements of the Collegiate Department of Civil Engineering, the several topics are briefly summarized. The general statement is made that:

The regular course of instruction of the best schools of this kind is given, and particular attention paid to those subjects which will especially engage the Engineer in the development of this State, namely: Irrigation, Mining, and Road and Railroad construction.

Drawing and Architecture, are included in this department.

DRAWING.

Work in the draughting room is required through nearly the whole course, and includes the use of instruments, Lettering, Plotting of Profiles, Topography, Stereotomy and Bridge design.

ARCHITECTURE.

Students in architecture will find much of this course adapted to their needs. Special instruction in architectural drawing will be given if called for. The history of architecture is taught in the Senior year.

MECHANIC ARTS.

At present the course in Mechanic Arts is consolidated with the course in Civil Engineering. This has been necessary as we have not as yet adequate shop room. Morever, our students have never had instruction in free hand drawing; so designing, working drawings and draughting are wholly out of the question.

Meanwhile Free Hand and Industrial Drawing is required of all students in the institution. The aim and character of this course are fully explained elsewhere.

As soon as the main building is completed a suite of rooms in the basement will be available for mechanical laboratory and shops.

It is the intention to give a complete collegiate course in the Mechanic Arts, embracing electrical engineering, mechanical engineering, architectural engineering and such other instruction as pertains to the "industries of life."

In its more elementary forms, available to the students of the Preparatory School, the course includes what is popularly known as Manual Training.

As the English course in the Preparatory School has been referred to, the outline of the collegiate course in English is of interest.

THE ENGLISH COURSE.

The collegiate course in English can not be outlined in this catalogue. Few schools in Idaho teach Latin, consequently many students will seek admission to the University who are deficient in this branch. It is presumed that many students will not care to be delayed in their cellegiate course by making up this deficiency. Furthermore there is good reason to believe that a course in English language and literature may produce highly disciplinary and practical results.

English in its various forms will be taught for its culture value, for its relations to the world's vital thought—in its best forms of expression—and to cultivate literary taste.

In connection with the English course it is planned to give a course in Political Science, Sociology and Finance, thereby qualifying the student for the great civic, economic and financial questions that to day demand of the citizen a trained mind.

correct moral bias, and the support of well formed foundation principles for orderly and safe consideration.

The entire course will be especially valuable to those preparing to teach, to engage in business or in public life. This course is now being considered and will be announced in the next catalogue.

Under the head of Drawing, a detailed programme of the course in the Preparatory and Collegiate departments, follows the statement here quoted.

DRAWING.

[Miss Bowman.]

A course of Free Hand and Industrial Drawing is open to all. Aside from its value as a means of culture it leads to habits of close observation and is a very important adjunct to the other courses, notably the biological, engineering, and industrial courses. For this reason the course is required in the Preparatory department. College students not taking Mechanical Drawing are required to take Free Hand the same number of hours.

The Course consists of :—

(1) Drawing from objects and casts in pencil, charcoal and crayon; also pen and ink drawings.

(2) Technical Perspective.

(3) Painting from still life, flowers, and fruits, in water colors and in oil.

(4) Modeling in clay from cast, photograph and nature.

A sketch class will be open to the students qualified to work in it, one afternoon each week in the spring and fall. In the winter sketches are made in the studio from casts, still life, or from life.

In all courses the work is made of direct benefit to the students in other lines and at the same time it aims to develop in them a love for and an appreciation of the beautiful.

The school owns a set of geometric solids and a small collection of casts, mainly of historic ornaments, which will be increased as needed. It is also hoped to secure a collection of foreign and American photographs.

As the "Experiment Station" law, and the additional appropriation to Colleges of Agriculture and the Mechanic Arts, made possible the establishment of this institution; these two departments of the University are of especial interest. The following statements about the College of Agriculture, show the important place it occupies.

COLLEGE OF AGRICULTURE—THE PURPOSE.

The College of Agriculture as a constituent college of the University has for its specific object the preparation of the young men of Idaho for successful farming, stock raising, fruit growing, dairying, and allied occupations. While this technical and practical knowledge is being imparted a broad course of training is given that fits the student for any station in life to which he may be called.

Accordingly the course in Agriculture is made equal in weight and dignity to the other courses, and leads to a degree of its own, that of Bachelor of Agricultural (B. Agr.). As the sciences and the mathematics lie at the basis of this course the student is offered the pure sciences of the scientific course and the pure mathematics of the mathematical course.

In the domain of the applied sciences and applied mathematics this course will be seen to be peculiarly strong and practical. In the latter branch, for instance, the student is qualified for farm, road, and irrigation surveying, for highway construction, platting, and the like.

While the collegiate course requires four years for completion, it is not intended to withhold this valuable instruction from those who are unable to take the full course.

It is the intention (1) to establish elementary courses in agriculture and allied subjects; (2) to offer winter courses of lectures to farmers and others in the University building; (3) to assist in organizing and maintaining farmers' institutes; (4) to aid horticultural, stock breeding and other societies; in other words to extend the benefits of the University, along these lines, to the various communities of the State, to carry the College of Agriculture and its benefits as far as possible to those unable to come to the University.

IRRIGATION.

No subject is more important to the development of this commonwealth than a thorough understanding of the possibilities of the arid lands of the State. The entire subject of irrigation, whether viewed as a problem in civil engineering or as a problem in chemistry or as a problem in agricultural or horticultural experimentation, will be thoroughly treated, both theoretically and practically.

ADVANTAGES.

The students of Agriculture enjoy every advantage afforded by the University. The Preparatory Department prepares for the course in Agriculture. The library of the University, the department libraries, the laboratories, the equipment of the civil engineering department, all are directly available to the students taking this course. Technical or professional instruction is given by the professor of agriculture and by the other professors of the University whenever the course of agriculture requires their services.

LABORATORY.

The laboratory of the University has been supplied with apparatus and reagents with special reference to the needs of the Experiment Stations.

The professor in charge, who is also chemist for the stations, is now prepared to analyze soils, waters, fertilizers, fuels, etc., and to instruct advanced students in the same.

LIBRARY.

The technical library of the College of Agriculture now contains the leading authorities of this and foreign countries upon the various subjects pertaining to scientific and practical agriculture.

The department of womans work on the Farm, as a part of the Experiment Station work, is a new departure—Like departments of household economy and work, have for some years, been organized in various colleges; an additional step is, however, taken here.

HOUSEHOLD SCIENCE.

I. Instruction will be given in all branches of domestic economy. This will include practical exercises in cooking, baking, preparation of jellies, preserves, condiments, etc.; construction of properly balanced rations, calculation of cost of food, preparation of menus, etc.; designing, cutting, fitting and making of garments; testing of cloth, threads, etc; fine needle work, embroidery, stamping, painting, and millinery; application of art, floriculture, etc., to home decoration; in fact every thing pertaining to the successful management of the household.

II. The professor of Household Science will act as domestic economist to the Experiment Station. This is a new departure in Station work; the object is to improve the quality and to reduce the cost of food; to devise labor-saving appliances for the household and to study methods of beautifying our homes.

Seven hundred and twenty thousand dollars are annually spent in the United States for experiment station work. This amount is used for investigating subjects pertaining to agriculture proper. How much of this sum is devoted to the aid of the housewife? Is not the work of the household as important and as valuable as the other and usual lines of experimentation?

The field is new and offers many problems for solution. The work will consist of original investigations in cooking, baking, preservation of meats and fruits, preparing jellies, condiments, etc., testing of new fruits; examination of food products for adulterants; testing of household machinery; testing recipes, etc. The results of these investigations will be published as soon as completed in the bulletins of this Station.

THE EXPERIMENT STATION.

An important feature in the equipment of the Agricultural College is the experiment Station.

This department consists of a central office and three experimental farms. These farms have been selected on account of their peculiar situation in regard to altitude, rainfall, etc., and serve very well to illustrate the various phases and conditions of Idaho Agriculture. The work of the Station consists of original investigations of the problems bearing upon agriculture and the practical application of the facts discovered.

* * * * * * *

ADDITIONAL EQUIPMENT.

The announcement is made that since beginning the publication of this pamphlet extensive and carefully selected additions to the equipment of the University have been made. The departments of Eugineering, Chemistry, Biology, Mechanical Drawing, and Meteorology have thus been materially augmented in efficiency. The working libraries of the various departments have also been extended by purchase of the latest authorities.

Total attendance of students for the year 1892–'93, is given as 134. Of these, 14 are in the Colleges—9 Freshmen, 4 Sophomores and 1 Junior. The College Faculty, comprises 12 Professors and Instructors. Of these, three are ladies. The Faculty of the College of Agriculture, numbers 10. Franklin B. Gault, M. S., President of University and College of Agriculture.

New Mexico College of Agriculture and Mechanic Arts, Las Cruces, Dona Ana County, New Mexico.

In 1888, in view of the passage of "The Hatch Act," establishing U. S. Agricultural Experiment Stations in the several States and Territories of the Union, some friends of Education in Las Cruces, procured the incorporation of an institution of learning under the name of Las Cruces College, secured a building and teachers, and opened for students in September, 1888. The Territorial Legisla-

ture, the next year, established the Agricultural College at Las Cruces, and connected with it the Government Experiment Station; the conditions of the law establishing which, were, at the same time, accepted. This Agricultural College, opened January 21st, 1890, with an attendance of thirty five students. The formal official opening ceremonies took place March 11th, with much enthusiasm; and were attended by the Governor, Territorial Officials, and leading citizens. The occasion of the opening of such an Institution devoted to higher education, was recognized as an important event. The citizens of the Mesilla Valley had given a valuable tract of land containing two hundred and fifty acres, for the uses of the College. This tract is situated about two miles south of Las Cruces, and the new building of the college is erected there. The college was first opened in a rented building in the town.

The first annual report by the Regents, to Governor Bradford R. Prince, for the year ending December 31st, 1890;* recites the fact of their organization in November, 1889, and of their success in securing the placing of the Experiment Station in connection with the college; they express the hope that the income of the supplementary Morrill Act, of 1890, will, also, be given to the college.

That this expectation was realized appears from the pamphlet containing the first and second annual reports made by President Hadley, in accordance with the United States law, to the Secretary of the Interior and to the Secretary of Agriculture.†

The President, recites the facts as to the origin of the college and of his being called to its head. As soon as it was reasonably certain that the further Government aid, given by the Morrill Bill of 1890, would be secured for this institution; the organization of the future College was, as fully as possible, provided for. The President of the Territorial Agricultural College had already been appointed Director of the U. S. Experiment Station.

A Preparatory School was established, and a four years College Course arranged. It was also determined to establish for the coming year, a department of Mechanical Engineering, and a fuller course in the Spanish Language. Concerning this study, President Hadley says:

> In this region a practical knowledge of the Spanish language is absolutely necessary to the successful "application" of Sciences in the "industries of life." Indeed, I doubt whether there is any other one branch of learning that has within

* First Annual Report of the Regents of the Agricultural College of New Mexico. 1890. Santa Fe, N. M.: New Mexico Printing Company. 1891. Pp. 7.

† New Mexico College of Agriculture and the Mechanic Arts. "Morrill Fund." First and Second Annual Reports of the President of the College and the Treasurer, as Required by the Act of Congress of August 30th, 1890, in aid of Colleges of Agriculture and the Mechanic Arts. Las Cruces, N. M.: The Rio Grande Republican. 1892. Pp. 24.

it so large possibilities of usefulness as a practical knowledge of Spanish has. In the region contributary to the College it is a necessity.

In the Second Annual Report for 1891–1892, the opening of the new Department of Mechanical Engineering is announced. The equipment of this new department, consists of five wood turning lathes, an engine of eight horse power, six cabinet maker's work benches, and twelve sets of carpenters tools.

The following extract from the Report, gives a graphic picture of the local surroundings, and of the obstacles to be overcome by those seeking an education. This, in connection with the need for a familiar knowledge of Spanish, referred to in the previous Report, illustrates how these institutions, situated in different, widely-separated localities, are, of necessity, modified in their development by their environment; while the fact that the existence of this particular institution is wholly due to the stimulus, and material aid afforded by National Legislation, has already been fully set forth.

The President says:

The advantages offered by the College are good and are highly appreciated by the people of New Mexico. In a sparsely settled Territory every isolated ranch or mining camp contains one young man or young woman, or more than one, who desires to attend such a school. In many cases whole families move by team from one hundred to two hundred miles and undergo many privations in order to enjoy these privileges.

The latest catalogue at hand, that for 1892–'93,* gives proof of a healthy growth and development of the College.

The following "Courses" are now offered:

COURSES OF STUDY.

(1) A course in Agriculture.
(2) A course in Mechanical Engineering.
(3) A course in Civil Engineering.
(4) A Ladies' course.
(5) An Elective Engineering course.

During the coming year, the above courses will be taught. In the Freshman year, the General course is the same for all male students. This becomes in the Sophomore year the Agricultural and the Engineering. The latter in the last two years becomes the Mechanical and the Civil Engineering courses.

In the Department of Mechanical Engineering, five alternative courses are offered. One of these is a special one;—a course of one or two years, in the draughting room and the shops, for students wishing only to acquire practical mechanical skill. Facilities are offered for instruction in Manual Training; in all branches of wood and iron work; also, in the theory and practice of higher Mechanical Engineering. Drawing, is begun in Sophomore year. Only Mechanical Drawing is taught; with one term of Architectural Drawing in Senior Year.

* New Mexico College of Agriculture and Mechanic Arts. Location: Las Cruces, Dona Ana Co., New Mexico. Catalogue for 1892–'93. And announcement for 1893–'94. Las Cruces, N. M. Rio Grande Republican. 1893. Pp. 47.

There is a single large, well constructed two story main building of brick with stone trimmings.

This, contains thirteen large rooms for recitations and a commodious public hall. There are as yet no dormitories, or boarding houses, connected with the College. There are several out buildings on the grounds; a ware-house for machinery, etc., a pump house with machinery for irrigation from the six wells; and "feed rooms, and horse sheds." "These are used to accomodate the horses of those students who ride to the college." A charge of 25 cents a term, is made "for the use of a horse stall." Citizens of the Territory, pay simply an "entrance fee each year of three dollars." "Students, not citizens of the United States," pay a tuition fee of Fifty Dollars. The College does not provide board or rooms. The cost for room and board, ranges from sixteen to twenty five dollars a month. Students are allowed to perform labor and to receive pay for such work as is needed in connection with the college. The college campus and the experiment farm are cultured by irrigation.

The total number of students in attendance for the year 1892–'93, is given as 109. Of these 37 are in the college, 11 of these are girls. The Board of Regents consists of five members appointed by the Governor; with the Governor and the Superintendent of Public Instruction members *ex officio*. The "faculty and other officers," number 13; Hiram Hadley, A. M., President.

Oklahoma Agricultural and Mechanical College, Stillwater, Payne County, Oklahoma.

The first Legislature of the New Territory accepted the provisions of the U. S. law of 1890, supplementary to the U. S. Land Grant Law of 1862; and, by act of December 22nd, 1890, directed the establishment of an Agricultural and Mechanical College in Payne County. A subsequent law, passsed in March, 1893, entered into various details respecting the government and organization of the College, the provisions for its support, the issue of Territorial bonds for it, and the levying of an annual tax of one-half mill on a dollar, for its benefit. Section 25 of this law, provides that "Citizens of Oklahoma between the ages of 14 and 30 years, who shall pass a satisfactory examination in reading, arithmetic, geography, English grammar, and U.S. history; and who are known to possess a good moral character, may be admitted to all the privileges of the institution." Persons not citizens of the Territory, will be charged a matriculation fee of twenty dollars; in other respects they enjoy all the rights and privileges of students who are citizens. The provisions of the U. S. law establishing Agricultural Experiment Stations were also accepted, and the Station was opened in connection with the College.

Stillwater, where the college is situated, is in the center of a fertile well watered valley. A farm of 120 acres, is devoted to the Department of Agriculture; while the Department of Horticulture has ample grounds.

The following statements are made in the Catalogue. *

PREFATORY.

The object of the Agricultural and Mechanical College is not to afford a Universal education, but a thorough teaching or training in the literature, arts, and sciences, supplemented by experimental labor, necessary to a first-class education in the various fields of business, and manual pursuits. * * *. Conforming to a well established custom, we have allotted four years, exclusive of the Preparatory Department, for the entire course. * *.

STUDENT LABOR.

The College will afford to its students the benefits of daily manual labor, most of which will be paid for, thus lessening their expenses. * * It is believed that two hours labor per day on the farm or in the garden, besides serving to render the student familiar with the use of implements and the principles of agriculture, is sufficient, also, to preserve habits of manual labor, and to foster a taste for agricultural pursuits. Every student in the agricultural course, not exempt on account of physical disability, is therefore required to labor two hours each week day, except Saturday, in those seasons of the year when labor can be furnished. At other seasons, an equal amount of time is required in laboratory or shop work, which being instructive is not paid for. * * *.

MECHANIC ARTS.

All students in the course of Mechanic Arts will be required to labor four hours per week in the shops. This work being instructive will not be paid for.

DRAWING.

In the college course, Drawing is taught through two terms in both the Sophomore and Junior years.

The Catalogue for 1893–4, shows an attendance of 132 students. 66 of these are in the Preparatory, 41 in the Freshman, and 25 in the Sophomore, classes. The Faculty numbers nine Professors and Instructors. R. J. Barker, C. E., President.

Agricultural College of Utah, Logan, Utah.

The act organizing this college was passed by the Legislature of the Territory March 8th, 1888, accepting the provisions of the U. S. Land Grant Law, known as the Morrill Law, of 1862. The U. S. law passed March 2nd, 1887, provided for the establishment of Experiment Stations; the law known as the Supplementary Morrill Law, was passed in August, 1890. In accepting the conditions of these two later laws the Territory was pledged to their execution in good faith.

* Annual Catalogue and Prospectus of the Oklahoma Agricultural and Mechanical College. Session of 1893–4. P. O. address, Stillwater, O. T. Telegraph and Express, Wharton, I. T. Guthrie, Ok. State Capital Pr'nt'g Co., 1893, Pp. 48.

The objects of the colleges, and of the Experiment Stations, being sufficiently set forth in the U. S. laws authorizing them, the Territorial Law defines these objects by quoting the language of the U. S. Laws concerning them. The influence of local conditions may perhaps be seen in section 10, of the Territorial Law, which provides as follows:

Sec. 10. In the appointment of professors, instructors and other officers and assistants of said college, and in prescribing the studies and exercises thereof, no partiality or preference shall be shown by the trustees to one sect or religious denomination over another, nor shall anything sectarian be taught therein; and persons engaged in conducting, governing, managing or controlling said college, and its students and exercises in all its parts, shall faithfully and impartially carry out the provisions of this act for the common good, irrespective of sects or parties, political or religious.

Instruction in the English Language and Literature and the modern sciences; in veterinary art, household economy, and "especially the application of science and of the mechanical arts to practical agriculture in the field," are required in the "course of instruction" laid down in the law.

The present resources of the Institution are derived from the two grants given by the acts of Congress, viz: to establish the Experiment Stations, and to supplement the gifts of the law of 1862, by the annual grant. The first, gives $15,000 a year, to the station; and the second, beginning at $15,000 a year, increases by $1,000 each year till it amounts to $25,000 annually; at which sum it is to continue indefinitely.

The Territorial act of organization gave $25,000 for buildings. The last General Assembly gave $48,000 and the present General Assembly gave $108,000 to the college. The total revenue available for the biennial period ending Dec., 1893 is $108,000.

When Utah is admitted as a State, the college will receive its quota of the U. S. Land Grant under the law of 1862.

LOCATION OF THE COLLEGE.

Cache County and Logan gave a farm of 100 acres, and thereby secured the location of the college at Logan. Logan is the capital city of Cache County, and, in a commercial sense of Cache Valley. It is surpassed in wealth and population by only three cities in Utah, and in the beauty of its location by none. Cache Valley is some sixty miles in length, twelve miles in width, and is completely surrounded by the Wasatch range of mountains. From the upper bench of the old lake formation, upon which the college and farm are located, can be seen, in the clear air of this inter-mountain region, the full expanse of the rich valley, while the uniquely corrugated mountain sides encircling the valley are seen in all their wealth of varied beauty. The beauty of this location is probably unsurpassed by that of any other college in the country. Logan has the characteristics of a beautiful college town. Its rural population is, in morals, second to no town in the Territory, and its size equals the demand upon it for boarding facilities. Board can be procured at lower rates than in large cities.

The latest catalogue at hand* is illustrated with views of the buildings. The frontispiece gives a front view of the main college building, a very large and imposing looking building; 342 feet in length, and 190 feet deep, in centre. The centre is a five storeyed structure with a very high central tower—the too wings are four stories in height with end towers. The roofs are high and steep. The catalogue describes it as "one of the largest college structures in the country." It contains class rooms, work rooms, a Laboratory a Museum, Library, Gymnasium, and Military drill hall; "each some 80 feet square." There is besides, "an Audience room, or Chapel," which will hold 1600 persons. There are, also, three large halls for Literary Societies. There is a boarding house connected with the College whch contains thirty three rooms. The other buildings comprise a model barn, a model farm house and dairy, three cottages for laborers, and a house for the superintendent of the farm.—There is a Library of some 3000 carefully selected books, which also receives the current periodicals. Collections for a Museum, have been begun. In each of the five departments a collection of apparatus and materials for illustration has been procured; some $35,000 having been thus expended.

Eighty five acres of land are used for instructions in the art and science of agriculture and horticulture. Three and one half acres of ground, located close to the college building, are set aside for the sole use of students for athletic sports.

COURSES OF STUDY

The college work includes five distinctive lines of instruction; four special courses, and a Preparatory Department.

1. Course in Agriculture
2. Course in Domestic Arts
3. Course in Mechanical Engineering
4. Course in Civil Engineering
5. Business Course.

The special courses are as follows:

1. Three Years' Course in Agriculture
2. Irrigation Engineering
3. Two Years Course in Domestic Arts

In addition to these special courses there have been organized two courses of winter lectures, covering ten weeks each, namely: A course of lectures for the Agricultural Department and a course of lectures for the Domestic Arts Department.

The Courses in Mechanical and Irrigation Engineering will be Post Graduate Courses of one year each.

The mineral resources of the Territory, and the need in many places of irrigation, are sufficient to call for special attention to training in civil and mining engineering and to the engineering problems affecting irrigation; and these indicate the probable influence of local needs upon the subjects selected for special attention. There

*Annual Catalogue of the Agricultural College of Utah, Logan, Utah. 1893–4. Ill. Pp. 73.

is, however, another peculiar feature of this College, which may, perhaps, be credited to environment. Like many others of its sister Colleges, its facilities are as freely offered to the daughters as to the sons of the State; but this College is peculiar in that the military drill, which is a part of the curriculum in the Land Grant colleges, is required of the girls, as well as of the boys; and light muskets are provided for the female soldiery.

In most of the courses, Drawing is taught through each term of Freshmen year. In the courses in "Agriculture," and in "Domestic Arts," Free hand only is taught.—In the Mechanical and Engineering courses Free hand is taught for one term and Mechanical for two. In Domestic Arts; Sewing, Dressmaking, Laundry Work, and Cooking, the latter both as an "art" and as a "science," are taught through the course. Drawing, is one of several "elective studies," which may be taken each term of Senior year. In the Mechanical Engineering Course; Shop Work goes through all the four years, with Drawing in some form.

Drawing is taught, also, in the shorter courses of Agriculture, Domestic Arts, and Engineering. Tuition is free. There is an annual entrance fee of five dollars. Board can be had from $2 to $3.50 per week.

The total number of students attending for the year 1893–4, is given as 361; of whom 134, were girls. There is nothing in the catalogue to show whether the students were in the Preparatory or Collegiate Departments, nor in what classes they were.

The Faculty numbers 19 Professors and Instructors. Jeremiah W. Sanborn, B. S. President

The Washington Agricultural College and School of Science, Pullman, Whitman County, Washington.

This College is beautifully situated on an elevation directly east of and overlooking the young, flourishing town of Pullman, in Whitman County. Its location in the midst of the famous Palouse Valley gives it unusual advantages for agricultural and other experimental purposes. Pullman is supplied with numerous artesian wells of pure water, is healthfully located and has an intellectual and enterprising population of fifteen hundred people. It is also readily accessible from different parts of the State by both the Union and Northern Pacific Railroads. * * * The Washington Agricultural College and School of Science was established by the legislature in two separate acts.*

The Legislature, in 1889, created a Commission to establish a State College and in the act designated a department of Agriculture; and directed seven different branches of study to be taught. This Commission did not succeed in finally locating and establishing the

*Second Annual Catalogue of the Washington Agricultural College and School of Science located at Pullman, Whitman County, Washington, 1892–'93. Olympia, Washington. O. C. White, State Printer 1893.—Pp 60

College, but the act authorizing its establishment was not repealed; the subsequent legislature, in 1891, accepted the conditions of the acts of Congress popularly known as the "Hatch act," and the "Morrill Act," and directed that:

> The Agricultural College Experiment Station and School of Science created and established by this act shall be an institution of learning open to the children of all the residents of this State and to such other persons as the Board of Regents may determine. * * * It shall be nonsectarian in character and devoted to practical instruction in agricultural, mechanic arts, natural sciences connected therewith, as well as a thorough course of instruction in all branches of learning bearing upon agriculture and other industrial pursuits.

A further provision enumerates a number of studies that must be taught, ending with:

> And such other sciences and courses of instruction as shall be prescribed by the Regents of this institution of learning.

A most liberal and wise provision.

The immediate income of the institution arises from the national grants of the Hatch Fund and the Morrill Fund. The U. S. Land Endowments amount, in addition, to 190,000 acres, which, in time, should result in a noble endowment; as yet none of this land has been sold. The State Legislature, in 1893, made an appropriation of $93,000 for buildings and expenses. Tuition is free in all departments—a moderate rental is charged for rooms in the buildings of the college. Students necessary expenses, exclusive of clothing, are estimated at a little less than two hundred dollars a year. Four "Courses of Study" are provided: 1, General Science; 2, Agriculture; 3, Civil Engineering; 4, Mechanical Engineering, including (a) course in Electrical Engineering; (b) course in Mill and Hydraulic Engineering; (c) course in Steam Engineering. The studies in these courses are essentially the same during the first three years; identically the same for Freshman year. Mechanical Drawing is taken one term of Freshman year—"Woodwork," and "Forging," also, each one term. In the Engineering courses, "Drawing," and "Shopwork" in some form, are taken through the entire course. The "Drawing" is, in all cases, Mechanical, or Machine Drawing. The regular course for Degrees is of four years. There is a "Preparatory Department;" with a course of two years. There are special courses in the College; without degrees.

In the second year of the "Preparatory Course," Free Hand Drawing may be taken for two terms. A series of "*Practicums*," run through all the courses; in these, practical training is given and required in those sciences, or occupations, whose theory is taught in the College. The college farm contains two hundred acres, which are all under cultivation. The grounds about the College contain thirty acres. This campus is contiguous to, and west of the farm, and is just outside the city limits of Pullman. There are

laboratories, shops, a large dormitory building, and a three-story wooden college building, "containing class rooms, laboratories and offices." A new administration building of stone and brick is being erected. Total number of students attending in all Departments for the years 1892–93, 235. There are, in the Preparatory Department, 128; there are, also, 55 special students. In the college proper there are 52 students, divided as follows: Freshman, 44; Sophomores, 7; Juniors, 0; Seniors, 1. The Faculty and Instructors, number 11. Enoch A. Bryan, M. A. President.

The University of Wyoming, Laramie, Wyoming.

A University, to be located in Laramie, was created by the law passed by the Ninth Territorial Legislature, in 1886. The building was authorized at a cost not to exceed the sum of $50,000. The act of Incorporation was very full, liberal and comprehensive in its provisions. The object was stated to be

> to provide efficient means for imparting to young men and young women, without regard to color, on equal terms, a liberal education and thorough knowledge of the different branches of literature, the arts and sciences, with their varied applications.*

A State tax of one eighth of a mill on all taxable property, was enacted; in order to secure the efficient management and support of the University.

The University, was opened September 6th, 1887, and was carried on, in accordance with the provisions of the law from which the above statement is quoted, for three years under the presidency of Ex-Governor John W. Hoyt.

The first State Legislature, in January 1891, authorized the University to receive the income of the U. S. grants to Agricultural Colleges arising from the so called "Morrill laws" of 1862, and 1890; and the "Hatch Act," of 1887.

This increase of income, enabled the faculty to be increased from its previous number of seven, to fifteen members.

> Six experiment farms were also established in different parts of the State; viz: at Laramie, Lander, Saratoga, Sheridan, Sundance and Wheatland. * * *
>
> The University is situated in the city of Laramie, on the Union Pacific Rail Road. The grounds are about twenty acres in extent, handsomely graded and ornamented with native trees, and located in the eastern portion of the city about half a mile from the railroad station.
>
> The University building is a beautiful structure that would honor any institution or city in the United States. It faces the west, and is about 150 feet in length and fifty feet in breadth, having three stories above the basement. The material used in its construction is native sandstone. * * * The auditorium in the second story is the finest assembly hall in the State, and will seat with comfort 500 people.

* The University of Wyoming. Catalogue for the years 1891–92. and announcements for the years 1892–93. Laramie, Wyoming, Republican Book and Job Print. 1892. Ill. Pp. 100.

MUSEUM.

The Museum has been fitted up with beautiful cases in which John D. Conley, Professor of Geology in the University, has placed his choice private collection of fossils, minerals and Indian and Mound builder's relics—the result of over twenty year's collecting. * * *

THE FARM.

The experimental farm of the Agricultural College is situated on the Pioneer Canal, about two miles west of the city.

DEPARTMENTS.

The University is composed of the following departments: The Academic Department composed of a two years Academic Course, a Sub Preparatory course or a Business Department.

The College of Liberal Arts with four courses of study, called Classical, Scientific, Philosophic, and Literary. * * * These college courses are of four years, and lead to degrees of B. A., B. S., B. P., and B. L.

A Normal School. * * The Agricultural College. * * The School of Mechanics and Manual Training offers courses of practical training in shop work, drawing, designing and wood carving—but no degrees are conferred.

The School of Irrigation Engineering will confer the degree of Bachelor of Irrigation Engineering on all completing the prescribed course of study.

Course of Electrical Engineering and Civil Engineering are soon to be established in the College of Mechanic Arts.

SPECIAL COURSES.

In all the departments students of an advanced age are permitted to pursue, under direction of the faculty, one or two distinct lines of study.

In the College courses: Drawing enters as a required study for the autumn term of the Philosophical, Literary, and Scientific, courses; and is, also, an elective study for the full year, in those courses. It does not appear in the programs of the Classical course.

It is taught during one term only, in the first year of the Normal course.

In the College of Mechanic Arts; Drawing appears in the schedule of studies through each term of the whole four years. Every student in the Agricultural course, is required to labor two or three hours for five week days each week, in the fields or shops. In the course in Mechanic Arts, students are required to labor eight to ten hours per week.

THE SCHOOL OF MECHANICS AND MANUAL TRAINING.

This school has been established as a department of the University to meet the wants of young men desiring to become mechanics.

There is a large general drawing room fitted with all needed drawing tables and cabinets, and with a "blue print," and a "dark," room, for reproduction of drawings.

In the basement there is a wood-work room with "fifteen sets of hand tools, two wood lathes, and a six horse power engine."

Tuition is free to citizens. Students not citizens of the State, pay five dollars a year as tuition fees. All students pay an annual fee of two dollars and a half for support of the Library and for incidental expenses. Cost of board in private families ranges from five dollars upwards.

Number of students in attendance for the year 1892–93, 107. In College, 18; Normal, 9; Mechanical, 9; Academical, 36; Special Courses, 5; Irregular 30.

The Faculty of the University for 1893–94, numbers 14 Professors and Instructors. A. A. Johnson, A. M., D. D., President.

Industrial Education for Colored Students.

In the former Slave States, owing to those provisions of the law of 1890 made to secure for colored youth a just share in the educational advantages provided by the National Government, new Institutions, or new departments in old ones, have been opened for the instruction of colored students in Agriculture and the Mechanic Arts. The National appropriations are apportioned between such institutions for the white and colored students; and generally, in accordance with the relative ratio of the colored and white school population in each State.

As much space has been given in the preceding chapters to detailed accounts of the three older and leading institutions for the instruction of colored youth; namely: 'Hampton Institute," in Virginia, established in 1868; Alcorn University, in Mississippi, established in 1871; and Claflin University, in South Carolina, opened in 1869 as a college for colored youth, and opened as the State Agricultural College in 1872; there will be no attempt to describe in fullness of detail the methods of the more recent schools. The aim in most of these new schools to give thoroughly practical training in the trades and industries most likely to be of service in the everyday life of the farmer, the mechanic, and the housekeeper, is very evident; and gives great promise of the practical value of the education to be received by their pupils.

Hampton, since it was the pioneer institution and has achieved marked success, may be held to furnish in many respects, an admirable model for these new schools; while the records of Alcorn, and Claflin, each with a history of nearly a quarter of a century of success, reinforce the Hampton lesson of the value of industrial training as a vital force in education.

Alabama. State Colored Normal and Industrial School, Normal, Alabama.

This school, organised in 1875 at Huntsville, Alabama, began with an annual appropriation of only one thousand dollars, with two teachers, and an attendance of some sixty pupils. This appropria-

tion was doubled in 1879. In 1882, the Principal and teachers donated one half their salaries for the purpose of securing a home for the school and, by great economies in expending the State appropriation and the donations from the Peabody, and Slater, Funds, in addition to individual contributions by friends of the school, the sum to purchase a desirable lot was accumulated and suitable buildings erected and deeded to the State. Industrial work was added at this time; the training before this had been entirely literary. In 1885, the Legislature, appreciating these successful efforts, "increased the annual appropriation to the sum of four thousand dollars and made this the industrial school for the colored people of Alabama;" and, in 1891, made it the beneficiary of the supplementary Morrill Fund of 1890.

It was then thought best to sell the Huntsville property and to acquire a farm in the vicinity. Accordingly a desirable place of 182 acres, some two miles from Huntsville, was purchased. This is situated on an elevation of 300 feet above Huntsville. Three fine large buildings suitable for dormitories, class rooms, and Chapel, have been built; and the old buildings renovated. A new barn, dairy house and other necessary buildings have already been built. Tuition is free; and board, including washing, fires, lights, and furnished room, except bed clothes, costs the pupils only seven dollars per month. The "Normal" Course, is one of three years; there is also a "Preparatory" school, with a course of two years; and a "Model" school. In the courses of study in the "Normal Department," Drawing finds place only in the second term of both the Junior and Middle years. The Faculty of the Normal Department numbers eleven. Five of these including the two "principals," are also enrolled among the Faculty of the Industrial Department.

The Industrial Department.*

The aim of the Institution is to give both practical and theoretical "instruction in Agriculture, the Mechanic Arts, the English Language and the various branches of Mathematical, Physical, Natural and Económic Science, with special reference to their application in the industries of life" thus giving to the State an intelligent, industrious citizen, with proper ideas of life and the relations of education and labor. The object is to have the student begin practical life right in the school-room, receiving here some useful trade or profession, or laying the foundation for the same. The results of the efforts of this Institution in this direction, in past years, plainly indicate the correctness of these methods. The head, the heart and the hand are harmoniously and conjointly developed and trained.

Further, the aim is to turn all labor, and all articles produced by labor, to advantage and utility. Therefore all of those industrial departments contribute in some way to the equipment of the Institution, and are, in most cases, a source of income to the student as well as a means of instruction.

*Catalogue of the State Colored Normal and Industrial School, Normal, Alabama. (Near Huntsville) 1892–93. Cincinnati, O: Elm Street Printing Co., 176 and 178 Elm St. 1893. Pp. 48.

A page of extracts from Professor Runkle, and other authorities on Manual Training, entitled "What is thought of Manual Training" follows. Then follow several pages in which the details of the courses of study in each branch are given in full for each year. In these courses the training seems to be very thorough, practical and direct. The following table shows the different industries taught and the number of students in each occupation. In the carpenter shop only hand tools are at present used. It is expected that steam power will eventually be provided.

Summary of Industrial Organization.

I. DEPARTMENT OF MECHANIC ARTS.

Sec. 1. Carpentry—Four classes, forty-four apprentices, two hours per day, three days per week.

Sec. 2. Printing—Three classes, nine apprentices, two hours per day, three days per week.

Sec. 3. Mattress-Making—One class, four apprentices, two hours per day, six days per week.

Sec. 4. Shoemaking—Three classes, thirty-one apprentices, two hours per day, three days per week.

Sec. 5. Blacksmithing—Three classes, twenty-seven apprentices, two hours per day, three days per week.

Sec. 6. Wheelwright Work—One class, four apprentices.

Sec. 7. Painting—One class, six apprentices.

II. DEPARTMENT OF AGRICULTURE.

Sec. 1. Farming and Horticulture—Three classes, thirty-three students, two to eight hours per day, six days per week.

Sec. 2. Dairy and Live Stock—One class, five students, two to eight hours per day, six days per week.

III. DEPARTMENT OF DOMESTIC SCIENCE.

Sec. 1. Laundry—Two classes, thirty-four members, two to six hours per day, six days per week.

Sec. 2. Cooking—Three classes, thirty-six members, one hour per day, two days per week.

Sec. 3. Cutting and Sewing—Three classes, seventy members, two to four hours per day.

Sec. 4. Nursing—Three classes, thirty members, two hours per day, three days per week.

Sec. 5. Housekeeping—Two classes, twenty members, two hours per day, three days per week.

The following "summary" shows the attendance of students for the year 1892–93.

SUMMARY.

	Males.	Females.	Total.
Post Graduates	1	0	1
Seniors	9	8	17
Middle Year	19	16	35
Junior Year	25	26	51
Senior Preparatory	17	23	40
Junior Preparatory	15	18	33
Model School	32	44	76
	118	135	253

The Faculty of the "Normal Department;" numbers eleven. The Faculty of the "Industrial Department;" numbers twelve. Five are members of both Faculties. The Teaching force thus numbers eighteen individual instructors. W. H. Councill, Principal.

BRANCH NORMAL COLLEGE OF THE ARKANSAS INDUSTRIAL UNIVERSITY, PINE BLUFF, ARKANSAS.

This institution is a Department of the Arkansas Industrial University and was established by law in 1873, and opened in 1875, for "the training of teachers for efficient service in the colored public schools of the State."

The school building, first occupied in January 1882, is described as one of the handsomest and best buildings in the State. It is of brick and contains a large assembly room and four recitation rooms. It is situated in a "beautiful tract of twenty acres of ground, in the suburb of Pine Bluff, Jefferson County, Arkansas." It is convenient to the junction of two railroads.

Students are appointed from the several counties to the Branch College, the same in number for each county as are allotted to the Parent University of Fayetteville. They are appointed by the County Court. "All students so appointed are entitled to four years free tuition, upon the payment of five dollars matriculation fee, in advance, at time of entering the school." Board including fuel, lights and washing, can be had in private families from eight to ten dollars per month.*

The Normal Course is of four years and is designed to be the equivalent of the usual college course of four years. There is a Preparatory Department of three years. Drawing is a required study during the first two years of the preparatory course. The "Forbriger" system is taught. Drawing does not appear as a required study in the schedules of the Normal or the Classical courses.

* Catalogue and circular of the Branch Normal College of the Arkansas Industrial University, located at Pine Bluff, Ark. For the year ending June 7, 1892, and announcement for 1892-3. Press Printing Company, Little Rock. Pp. 30.

THE DEPARTMENT OF MECHANIC ARTS.

This addition to the Normal College had its origin in the appropriation of the supplementary Morrill bill, the annual income of which is to be divided between the white and colored youths of the State. The quota coming to the colored youths of Arkansas is assigned to this Department of the Branch Normal College.

THE EQUIPMENT.

The shop building was completed in February, 1892. It is of brick, 70 x 70 and comprises a wood shop, a foundry, a blacksmith shop, a machine shop and a boiler room. The wood shop has 12 benches with complete sets of carpenters tools, a double circular sawing machine, scroll saw, buzz planer and six woodturning lathes.

The Foundry has a Collan cupola capable of melting $1\frac{1}{2}$ tons per hour.

The Forge Shop. Twelve Buffalo forges are in position. * *.

Machine Shop. A 15 inch crank shaper, 24 x 24 x 6 feet planer, 20 inch drill press, 15 inch x 5 feet turret lathe, 18 x 6 inch engine lathe, 14 inch x 6 feet engine lathe, 12 inch x 5 feet hand lathe, universal milling machine, cutter and reamer grinder, twist drill grinder, power grindstone, etc.

Heat and Power Plant. Two vertical engines of 12 horse power each; and two 30-horse power tubular boilers. * *

An abundant water supply. Shops in best sanitary condition.

GENERAL STATEMENT.

The shops of the Branch Normal College are built and equipped for the purpose of giving the colored boys of our State a chance to make themselves useful by learning to be carpenters, pattern-makers, moulders, blacksmiths, machinists, and engineers or firemen. The shops will accomodate sixty students at one time, as follows: Wood shop, 18. Foundry 12. Forge shop 12. Machine shop 14. Tool rooms 2. Boiler room 2.=60.

While learning the basis of his trade, the student acquires a good knowledge of Language, History, Mathematics and Drawing. Throughout the course of four years in the shops, the student spends an average of ten hours a week in actual labor; and while the amount of time spent in the shops seems small, experience has shown that students under constant instruction from skilled teachers and passed from one exercise to another as soon as the work is well done, make very rapid progress: We are therefore prepared to offer:

(*a*) A course in general shop work extending over three years, followed by a fourth year's work in one of the shops selected by the student. The design is to enable a young man to choose his trade intelligently and to acquire a sound basis for it.

(*b*) A three years course in general shop work followed by a fourth year's work in the management of boilers, engines, and heating systems. This course is intended to train young men for the practical work of firemen and engineers.

(*c*) A course in general shop work extending over three years, together with class-room work in the theory and practice of teaching, followed by a fourth year's work in handling classes in the shops and in laying out series of practical exercises There are industrial schools for colored boys springing up all over the South, and we hope by this course to help supply the demand for trained shop teachers.

In the Mechanic Arts Course and in the Manuel Training Normal Course, the studies and shop work are very much alike, there are

however, more hours of the shop work per week, in the Mechanic Arts Course.

Drawing offers but one term in the Sub Freshman Class of Mechanic Arts, and is not taught in the other course, but much time is given to various kinds of shop work.

The Catalogue gives no separate list of pupils in the Department of Mechanic Arts. A total attendance of 233 is given; 57 "Normal," and 176 "Preparatory."

The Faculty consists of four Instructors. In the Department of Mechanic Arts there are six places in the Faculty, of which only two are given as filled.

In the Department of Mechanic Arts; C. V. Kerr, is Superintendent. J. C. Corbin, A. M., Principal of Branch Normal College of the Arkansas Industrial University.

State College for Colored Students. Dover, Delaware.*

The Catalogue of this Institution contains no dates of its history. It may have been founded yesterday, or a hundred years ago, so far as any information as to the time or circumstances attending its establishment is vouchsafed. The following statements however are given.

GENERAL REMARKS.

The college is established and maintained by appropriations from the Federal and State governments. It is located two miles north from Dover, the State capital, on the Lockerman farm, a tract of about one hundred acres. The facilities for instruction are an ample equipment of chemical and philosophical apparatus of modern and approved character and a workshop which is amply fitted up with tools and machinery for teaching the industrial arts. These include a large boiler and engine, lathe, drill press, shaper, forges, and carpenter's benches; with the necessary tools for iron and wood working, and a set of farrier's tools. A plant for electric light has also been installed. The shop will be opened at the beginning of the fall term, and will be under the charge of a competent instructor, and will be kept running throughout the college year. Thus facilities are afforded for acquiring skill in the trades—carpentry, blacksmithing, carriage making, etc.

The farm not only furnishes adequate facilities for instruction in the various branches of agriculture and horticulture, but also provides labor for the industrious student, who by this means and the long summer vacation, may earn a large part of his expenses, by his own exertions, during his college course.

COURSES OF STUDY.

Five courses of study have been arranged, namely: Classical, Scientific, Agricultural, Engineering and Chemistry. Each course covers a period of four years. * * *

Students must be not less than 14 years of age, of good moral character, and pass an examination in the ordinary English studies. * * *

Tuition is free to all Delaware students. Others will be charged $10.00 per term. Students will be boarded at the College at cost, which will not exceed $2. per week. * * *

*Catalogue of State College for Colored Students. Dover, Delaware, 1893. Pp. 6.

Total number of students for the year 1892-3, 22. Number of Faculty 3. L. D. Hileland, Instructor in Shop Work. Wesley Webb, M. S. President.

STATE NORMAL AND INDUSTRIAL COLLEGE FOR COLORED STUDENTS. TALLAHASSEE, FLORIDA.*

HISTORY.

The College was established in 1887, in accordance with constitutional provision, * * and by Legislative enactment; * * it was located at Tallahasse, with an annual appropriation of $4,000 made for its maintenance.

By action of the State Board of Education, it was started October 5, 1887, in charge of T. De. S. Tucker, Principal, and T. V. Gibbs, Asst.-Principal, with an attendance of fifteen pupils, who had succeeded in passing the preliminary examination.

In 1891, the school, having outgrown its accommodations in the city, was moved out to Highwood, in the suburbs of Tallahasse, where, on a large and historic plantation of over a hundred acres, the State has made extensive preparation to accommodate all who may come. The number of teachers has been largely increased and the equipment and facilities made among the best in the South.

SUPPORT.

The College is supported by annual appropriations from the Federal and State Governments. It was established and, prior to 1891, maintained by the State as a school for normal and manual training of teachers. This feature of the work of the school is still maintained as the specific end and aim of the institution. * * *

The appropriation for Florida, (under the Morrill law of 1890) * * * has been equally divided between the State Agricultural and Mechanical College, for white students, and the State Normal and Industrial College, for colored students. The State continues its annual appropriations as its share of the support of the school.

LOCATION.

Tallahasse, * * is the capital of the State of Florida and the county seat of Leon County. * * It is a town of about 3,000 inhabitants. * * The school site is a magnificent property, with spacions campus shaded by stately trees and located within easy reach of the city, on a high hill overlooking the Garden City, while on either side the well tilled acres of the college farm stretch away across the surrounding valley. The grounds and buildings are lighted by gas. Comfortable and convenient dormitory accommodations have been provided. These dormitories are conducted and controlled by the Faculty, and, unless excused by special permission of the President, all students not residents of Tallahasse will be reqnired to board at the school. * * *

APPARATUS.

The Physical Laboratory contains a complete set of apparatus of about one hundred and forty pieces. * * The Chemical Laboratory contains apparatus and chemicals for work, in the study of the science; and for such special work * * * as may be needed in agricultural experiments on the farm. * * * The Mathematical department is supplied with a carefully selected equipment of valuable apparatus. * *

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* Sixth Annual Catalogue of the Florida State Normal and Industrial College for Colored Students. Tallahasse, Florida, 1892–1893. Jacksonville, Fla., The De Costa Printing Co., 1893. Pp. 37.

EXPENSES.

There is no charge for tuition. The necessary expenses for the school year, rating board at $7 per month, are estimated at $83.50. * * * A few students can have the opportunity of remunerative work. * * *

MUSIC, DRAWING AND ELOCUTION.

Special attention is given to vocal music, free hand drawing, and elocution throughout the course. * *.

ORGANIZATION.

The college, as at present organized, consist of a Literary, a Musical, and an Industrial Course.

The Literary Course comprises the Normal and the Preparatory Departments. * * *. The Preparatory Course covers a period of five years. * *. The Normal Course covers a period of two years. To enter this department applicants must be 16 years of age, and pass a satisfactory examination in all the common school branches of study, and in Latin, to Cæsar. * *. No student will be allowed to graduate without taking the full two years' course,

The Musical Department, both vocal and instrumental, is under the care of a thoroughly practical and successful teacher, a graduate from England, trained in the Queen's private chapel, St. James, in London. Pupils may receive a partial or a full course; the latter of which covers a period of four years and embraces instruction in Thorough Bass, Harmony, Orchestration and Composition. * Instruction in vocal music is free

INDUSTRIAL COURSE.

This course comprises at present the Mechanical, Agricultural and Dairy Departments. * *

THE MECHANICAL DEPARTMENT.

This department is under the control of a thoroughly educated and skilled mechanic and an experienced teacher. The course of study and practice covers a period of five years. All graduates from the full course will receive the degree of M. E. The training includes exercises in carpentry, cabinet making, wood-turning, pattern making, moulding, casting, forging, brazing, soldering, tempering, chipping, filing, and general machine shop work. The course also embraces a number of finished articles. Instruction is given in the proper care of steam engines and boilers, and in mechanical drawing throughout the whole course.

The equipment of the wood room is as follows:

1 10 horse power horizontal engine and boiler.
1 circular saw.
1 Band saw.
1 jig saw.
1 Grind stone.
1 speed Lathe, 12 foot bed, 14 inch swing.
6 speed Lathes, 3 foot beds, 8-inch swing.
20 cabinet maker's benches.
Bench and turning tools for twenty-seven boys.
Much of the furniture in use in the school is made in this department.

AGRICULTURAL DEPARTMENT.

The department of Agriculture is comprehensive in its scope, embracing the culture of all the semi-tropical field crops,—gardening, fruit growing, dairy husbandry, rearing of live stock, poultry and drainage.

This department in all its branches, is under the immediate supervision and direction of the Professor of Agriculture, and affords the best facilities to illustrate by actual practice the theories taught in the class room.

Agriculture in its several branches is taught as an applied science.

Lectures by the Professor of Agriculture upon the science of Agriculture are delivered to the section daily. The students are then taken to the field where the practical application of the scientific principles taught are demonstrated. * * * A full and complete outfit of farm machinery and implements is provided on the place. * * *

DAIRY DEPARTMENT.

Special attention is given in the course of lectures to dairy husbandry, covering the theory in breeding dairy stock, feeding for milk and butter, and of making and shipping milk, cream, butter and cheese, and the practical methods of doing work in different sections of the country. * * * Fair compensation is allowed the student for remunerative work done on the farm or in the Mechanical Hall. * * * . Industrial training for young ladies is a growing feature in the work of the school. * * The school has been exceptionally fortunate in securing the services of a matron of rare qualifications—a lady of fine culture, ripe experience, and thorough devotion to her work. * * * .

Total number of Students in attendance in all departments, for the year 1892–93, 75. Of these, 9 were in the Normal Course. 4 boys, 5 girls. In the Preparatory Course there were 27 boys, and 39 girls.

In the Industrial Department; there were 30 in both the Agricultural and Mechanical course, and 22 in the Dairying.

In the Musical Department there were 19.

The Faculty comprises eight Professors and Instructors.—T. De S. Tucker, A. M., President, Professor of Mental and Moral Philosophy.

THE GEORGIA STATE INDUSTRIAL COLLEGE, COLLEGE, GEORGIA.

The Legislature of Georgia by act of November 26, 1890, established a school for colored persons as a part of the State University. This institution, it was provided, was to "be located within or near the corporate limits of that city or town in the State which shall offer the best inducements for such location, in the opinion of said Commission."

What city or town offered such prevailing inducement does not appear, from the latest Catalogue at hand.*

It *is* stated however, in the Catalogue, that

there is established in the College. a regular post office. The name of the office is "College, Georgia." All mail matter should be plainly directed to "College, Chatham County, Georgia."

This will probably sufficiently indicate to residents of the State the precise location of the College, but to others it conveys very little information as to its relative locality.

THE COLLEGE.

The Georgia State Industrial College is a State institution, the only one of the kind in Georgia for colored youths. It is endowed by the general government and

*Announcement and Catalogue. The Georgia State Industrial College, College Ga. 1892–93—Robinson Steam Printing Co., Savannah, Ga., 1893. Pp. 257.

supported by the State. The grounds are now about eighty six acres, consisting of thirty five acres in the Campus, and fifty acres in the College farm. The Campus, shaded by tall live-oaks festooned by pretty pendant moss, is for natural scenery the most attractive in the State. The location is perfectly healthful.

The College farm is separated from the Campus only by the railroad by which passengers are conveyed to our grounds. There are at present four main buildings on the grounds—Dormitory, School Building, Farm House and President's Residence.

The courses at present established are the Industrial, Sub Normal, Normal and Collegiate.

The conditions of admission are 14 years of age, a good moral character, and passing an examination in the elementary English studies. Tuition is free to all citizens of Georgia. Cost of board is estimated at $50 for the Academical year.

DEPARTMENT OF MECHANIC ARTS.

A. Alexander Ashton, Supt.

This department comprises eight branches: Carpentry, Wagon and Carriage making, Blacksmithing, Painting, Mechanical Drawing, Bricklaying, Printing, Typewriting and Stenography. Experienced persons will teach each branch. Each student on entering the Normal Course is required to select the trade which he is expected to complete.

This course covers three years and is taken in connection with the Normal Course. Every student is required to devote ten or more hours each week to his trade.

The course is practical, every student working with his instructor upon general repairs and manufactures. As soon as he is competent to do efficient service he is paid for all extra work. In this way it is designed to turn out practical and efficient workmen. Indeed the aim of this department is to so train the student, in giving him a trade, as to develop his love for honest work and instill in him habits of neatness, exactness and perseverance, and thus make him a useful and intelligent citizen.

AGRICULTURAL DEPARTMENT.

R. H. Thomas, Superintendent.

The aim of this Department is to give the student a practical as well as a scientific knowledge of farming. * * The farm is fairly well supplied with the latest agricultural implements. * * *

SCIENTIFIC DEPARTMENT.

D. C. Suggs, A. M.

It is the design of this department to furnish a general knowledge of all the subjects usually embraced in a scientific course, special emphasis being placed upon those topics which subserve a practical purpose.

There is a Sub Normal Course of one year, a Normal Course of three years and a College Course of four years. The Catalogue contains a copy of the "Code of Laws for the Government of the Georgia State Industrial College" in five chapters. The provisions regarding "the possession of weapons;" and in regard to "duelling;" read rather singularly to a Northern reader; but, if needed at all, are certainly very sensible provisions.

The total attendance of students for the years 1892–'93, is 65—4 only in the College department.

The Faculty number nine. R. R. Wright, A. M., President.

State Normal School for Colored Persons, Frankfort, Kentucky.

"This institution is situated about one and one half miles from Frankfort on a beautiful hill overlooking the City. The site comprises twenty five acres of tillable land and meadow, upon which are located the main school buildings with recitation room and chapel; a new mechanical shop, forty feet by sixty feet, with modern equipment and furnishings; the "Ladies' Hall" recently built, and cottages for the resident professors."*

This school was founded some few years since, by act of the State Legislature, for "the preparation of teachers for teaching in the colored public schools of Kentucky."

The regular Normal Course is one of three years. Applicants must be 16 years of age, or over, must possess good health and good moral character, and must pass successfully examination on the studies of the public schools; must also, sign a written agreement to teach in the public schools of the State twice the length of time that they remain in the school. For colored residents in the State, tuition is free; colored non-residents pay two dollars a month. Board is $8.00 per month in families. The girls board in the school for $7.50 per month.

The Industrial Departments were established to secure the advantages made possible by the appropriation given by the U. S. law of 1890, for the benefit of the Colleges of Agriculture and the Mechanic Arts.

Of the annual amount thus appropriated to Kentucky, 14.5 per cent is given to this school for the benefit of the colored youth of the State; the division being made "on the basis of the percentage of colored pupil children of the State according to the Census Bureau. For the financial year 1892–'93, the amount is $2,175."

Three special departments; namely: "Agriculture and Horticulture;" "Mechanics and Manual Training; and "Domestic Economy;" are thus maintained.

The aim is "to afford to every pupil a good, practical English education, with effective training in the Laboratory, and the field, or in the workshop." These Industrial courses are each of three years. The programme of the Agricultural course indicates a thorough practical course in the "Theory and Practice of farming." In the Mechanical Department a new building, 40 x 60 feet, has been built by the stu-

* Seventh Annual Catalogue of the State Normal School for colored persons for 1893–'94, and Annual Announcement for 1894–'95, Frankfort, Ky. 1894. Pp. 32.

dents and equipped with six carpenters double benches; there is, also, such modern machinery as is requisite to fit a first class shop. The programme of the course includes for the first year, Physics, Drawing, Algebra, Physical Geography, Shopwork. In 2nd and 3d terms of first year "Penmanship and Bookkeeping," are taken instead of Physical Geography; and in the 3d term, "Composition and Rhetoric," take the place of Physics. For the second year, General History, English Literature, Algebra, Drawing, and Shopwork, occupy the first two terms. In the third term of second year the studies are: Botany, Elementary Mechanics, Geometry, Roof and Bridges and Shopwork. In the third year, the studies vary more fromterm to term. The list reads 1st term: Chemistry, Strength of Material, Drawing, Shopwork. 2nd term: Chemistry, Moral Philosophy, Drawing, Shopwork. 3rd term: Belts and Pulleys, Steam Engine and Boilers, Drawing, Shopwork.

This course "is designed to turn out thorough finished and educated workmen. The course of 'shopwork' begins with the care and use of tools; exercises with the saw, plane, chisel, etc.; exercises in mortising, tenoning, splicing, dove-tailing, chamfering, etc., leading up to the manufacture of all kinds of joinery, turned and scroll work, cabinet-making. Stair building and practical house-building are made special features of the course.

Drawing extends throughout the entire course. It begins with plain, free hand drawing, rough sketches, geometrical drawing with instruments, leading up to projections, details, architectural designing, house plans, estimates and specifications."

The "Domestic Economy Course" is designed for the young women students.

"A general knowledge of Housekeeping, including something of Cooking, Laundry-work, Plain, Hand and Machine sewing, Draughting, Cutting, Fitting and Dress-making is required.

No young lady will be graduated from any of the departments who has not acquired a reasonable degree of proficiency in the course as outlined in the Domestic Department." This course in each term of the first year comprises "Housekeeping, Plain Cooking, Laundry Work, Hand-Sewing, including Darning and Patching." The course for the second year is as follows: "Housekeeping, Fancy Cooking, Fine Laundry, Machine Sewing, Measuring, Draughting, Knitting and Crocheting." For the third year, the course comprises "Housekeeping, Cutting and Fitting, Dress-making and Fancy Work."

The training given in the Industrial Departments, if we may judge from the outline of studies, seems to be eminently practical and judicious. To enable the pupils to become skilled farmers and mechanics, and good housekeepers, cooks, dressmakers, etc., is certainly well calculated to fit them to become good, useful and valued citizens in any community. There is, also, a Business Course of two

years; for entrance to which a satisfactory examination in the common school studies must be passed. There is a thorough Preparatory Course of two years connected with the Normal School; and all who enter the School must have passed satisfactorily this course, or its equivalent, as given in the Common schools of the State. "Practical work in the field, the shop, or the home, is required of all students in this Preparatory Department," as well as of all in the higher departments of the Normal School. The purpose of giving a thorough and practical education is kept ever in view.

Total number of students 114. Of these 38 are boys and 76 girls.—In Preparatory Department 22. The Faculty and Instructors number eight. John H. Jackson, A. B., A. M. President.

Southern University, New Orleans, Louisiana.

The Law, incorporating and establishing this institution for the higher "education of persons of color," was approved April 10th, 1880. Provision for the establishment of such an institution was incorporated in the Constitution of the State by the Constitutional Convention of 1879, through the efforts of Ex U. S. Senator Pinchback, of New Orleans, ; and Messrs. T. T. Allain, of Iberville, La., and Mr. Henry Dewas, of St. Johns Parish, La.

The Constitution provided for an annual appropriation between the limits of Five and Ten Thousand Dollars.* A special appropriation was also made to provide suitable grounds and buildings for the University.

SCOPE AND DESIGN OF THE UNIVERSITY.

This institution, and its support is the contribution of this State to the higher education of its colored people. It was intended to supplement the public school by offering college instruction and industrial normal training under conditions calculated to stimulate the desire for thorough classical and practical education among the colored people of the State. While college work is its proper field of labor, it has done much High School and primary work under the pressure of local necessities. This preparatory work has been subsidiary to the original design of college work. As the pupils have been advanced to the higher grades, lower grades have been dropped. There still remain several of the lower grades. As a State University the expediency and propriety of attaching Law and Medical Departments has been suggested, and they will be in operation as soon as proper arrangements are made.

BUILDINGS AND GROUNDS.

The building formerly occupied was sufficient to accommodate only city patronage. By permission of the Legislature this building was sold and a beautiful square of ground on Magazine and Sonial streets purchased, and a new and commodious brick building erected. In the month of March, 1887, this new University building situated on Magazine street, was opened with appropriate ceremonies. It is one

* The above facts are compiled from the statements in the Catalogue of Southern University, New Orleans, La., 1892–93. III. Pp. 61.

of the finest buildings in the city, situated in the midst of a beautiful square of ground, surrounded by live oaks and other trees. * * The Doric columns and Gothic arches, the marble entrance and the beautiful galleries adorning the front render the building very conspicuous.

In the spacious grounds ample room is afforded for youthful sports. There is in the rear of the central building, a large and well equipped Mechanical Building, containing steam engine, turning lathes, band saws, scroll saws and other machinery run by steam, and such other constructions and appliances necessary for the training of boys to be skilled mechanics. This building, in addition to the Southern University Farm above New Orleans, is equipped and supported by the annual Congressional appropriation for the Agricultural and Mechanical Department of Southern University. This industrial building will be enlarged, as the necessities require, to accord with the demand for more room made by this Department. The location of the University is healthful, being on the highest ground in the city, and within a few squares of the Mississippi river.

In the University buildings the industrial departments, both for boys and girls, will receive the attention they need, and will be provided with the conveniences necessary for successful operation, to the extent of the financial ability of the Board.

* * * * * * *

GIRLS' INDUSTRIAL DEPARTMENT.

This department organized eight years ago, has trained hundreds of girls in the use of the needle and the machine, and in the making of clothing and various other articles. It has proven a success, and is a department that reflects great credit on the pupils.

The work is regularly and systematically graded, beginning with the plain and simple, and advancing to the costly and intricate. The pupils furnish their own materials.

Students in this department are thoroughly instructed in all manner of needle work, and in cutting and fitting. Those pupils who complete a course in this department receive a certificate stating the same. We design the addition of such industries as will afford them the means of earning an honorable and competent livelihood. We are planning to make this department during the coming session, a greater success than ever before.

Agricultural and Mechanical Department.

In June, 1890, this department was organized.

Professor Hugh Jamieson was elected Superintendent of this department. An excellent farm of over one hundred acres of tillable land was secured and is now in operation, near the upper suburbs of New Orleans, and fronting on the Mississippi river. This farm has been stocked with teams and implements necessary for the cultivation of the various agricultural products of Louisana. Dormitories for agricultural students and a room for class exercises have been erected on this farm. * * * The pupils are taught theoretical, scientific farming in classes, and the result is shown in the practical application in the fields. The soil is analyzed in the chemical laborator— and its deficiencies supplied.

THE MECHANICAL DEPARTMENT.

At the beginning of the session, students were enrolled in both sections of the Agricultural and Mechanical Department. The Mechanical Building has been stocked with work benches, tools, steam engine and machinery, where pupils are daily taught in alternating classes.

The two sections are placed under competent instructors, and students are taught scientific agriculture, horticulture, and the mechanic arts.

Professor William Seymour, a practical mechanic, of experience and reputation, has been elected principal of the mechanical section.

The studies embrace both the theory and practice of mechanics. The pupils have made rapid progress in the handling of tools and in the character of the work.

All colored residents of the State of Louisiana, of both sexes, are entitled to admission to this University, on passing the entrance examination, free of all charges.

DEPARTMENTS.

The school is divided into the following departments.

I. College Department.
II. Normal Department.
III. High School Department.
IV. Grammar School (Preparatory) Department.
V. Girls Industrial Department.
VI. Agricultural and Mechanical Department.
VII. Department of Music.

Graduation in this University depends rather on the Course of Study successfully done, than on the time given to the course.

In both the "Classical" and the "Scientific" Courses Drawing is a required study throughout Freshman year. It does not appear in the schedule of studies in classes after Freshman year. In the Agricultural Department, the course is one of two years. In the Mechanical Section, the course is one of three years. Any pupil of the University fourteen years of age, can enter this department. Younger pupils may be entered by vote of the Faculty. In the Girls' Industrial Department, the course is one of three years. In the Music Department, the course is one of five years.

The total number of Students in attendance for the year 1892–93, was 623; of whom, 389, were girls; and 234, boys. In the college, only the Freshman class was represented; and by 3 members. In the Branch School at the Farm, there were 12 pupils; 6 boys, and 6 girls. In the Industrial Department, there were 184; 42, in the Agricultural Section; 45, in the Mechanical Section; and 97, in the Girl's Industrial Department.

The Faculty of the University numbers Nine Professors and Instructors.

H. A. Hill, President and Professor of Mental and Moral Philosophy.

LINCOLN INSTITUTE, JEFFERSON CITY, MISSOURI.

This institution, which is designated by the State authorities to receive that portion of the National appropriation coming to Missouri, which is available for the training of colored youth, had its origin in the desire of certain colored soldiers of the Union at the

close of the war to contribute directly to the educational development of their own people. Eventually becoming a State school it has received liberal appropriations from the State.

Although unfortunately no late catalogues or reports are accessible for use in the preparation of this account, it has nevertheless been thought desirable that it should not be wholly omitted in this resumé of the educational facilities for the colored youth of the country, which are aided by the General Government; and, therefore, the historical statements which follow are condensed from the latest catalogue* at hand.

Historical Sketch.

Lincoln Institute had its origin in a fund of $6,379, contributed by the 62nd and 65th regiments of U. S. Colored Infantry, when discharged from service in January, 1866, of which the 62nd gave $5,000. The only condition of the gift was, that a school be established in Missouri open to the colored people.

The Board of Trustees, ten in number, was organized on June 25th 1865, and the school was opened September 17. 1866 For the first few years "the school was taught in rented buildings, and had many obstacles to meet."

In June, 1871, the present Lincoln Institute building was completed. It is a substantial brick, 60x70 feet, three stories, conveniently arranged, and eligibly located upon a prominent hill, just outside the limits of Jefferson City, commanding a view of a large part of it. The grounds contain twenty acres.

The Legislature of 1879 appropriated $15,000 for the support of the Institute. * * *

Since the Institute became a State school, the Legislature has not only made large appropriations for its maintenance, but has also given money to erect a dormitory for young ladies, to purchase scientific apparatus, to make additions to the library and repair the main building.

By an act of the Thirty-fourth General Assembly, a college and a college preparatory school were established in connection with the Institute. * * *

By an act of the Thirty-sixth General Assembly, an industrial department was established in connection with the Institute.

No fees of any kind are charged in the Normal Department. Pupils pay an incidental fee of fifty cents on entering the Elementary Department and one dollar on entering either the Preparatory or College Department. In addition to the main building there are two large Dormitory buildings for boarding students. Board costs eight dollars and a half a month.

The catalogue gives a total of 208 students for the year 1890–91. A statistical return for 1893. gives a total of 264 students. 73 boys in Agriculture and Mechanic Arts. and 117 boys and 74 girls in other courses. with 8 Professors and Instructors. Inman E. Page, A. M. President.

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*Twentieth Annual Catalogue of Lincoln Institute, Jefferson City, Mo. 1890–1891. Jefferson City, Mo.: Tribune Printing Company, State Printers and Binders. 1891. Pp. 30.

Agricultural and Mechanical College for the Colored Race. Greensboro, North Carolina.

This new institution established by the State Legislature in accordance with the U. S. Law of 1890 expected to take possession of the College Buildings which have been erected in Greensboro, and to begin as a separate and independent institution early in November 1893.

The President states in his report to the U. S. Secretaries of the Interior and of Agriculture, that the main building for the new college is one of the finest public buildings of the State; that it is to be heated with steam and is completely finished and furnished throughout in the best manner.

Thus far this school has been conducted as an Annex to Shaw University in Raleigh. As that institution has no Agricultural department or any facilities for teaching Agriculture practically the A & M students have taken "only the Mechanical Course, principally in the preparatory department."

From the report made by the President of the Shaw University to the President and Trustees of the A & M College, it appears that for the year 1892–93, one hundred and two pupils have attended the A & M Annex to the University which was supported by the A & M Authorities.

The Industrial work undertaken on several lines, had in view practical teaching of processes incident to the demands of daily life on the farm, or in the home. In blacksmithing, for instance, the boys are taught to make bolts; to turn a horse shoe; to set wagon tires, etc., etc.,. Seventeen pupils took this course. In carpentry twenty pupils were kept busy in repairing and completing a building; and, later, were trained in shop work. In short to teach the use of tools and the every day arts was the aim of the practical instruction given. The new Machine Shop was being fitted with the necessary engines and machines and the pupils were employed in this work of setting them in place, and were then taught to manage a steam boiler and engine, and to use all kinds of wood cutting power machines; also to use engine lathes in the turning of metals, etc.,

In furniture making, twenty-seven students were employed under a competent instructor, in making and repairing all kinds of furniture and in the arts of painting and varnishing. All the students attended regular classes in English studies.

There are fourteen acres of land attached to the college in Greensboro, ten acres of which are under cultivation. This college receives an annual income of more than six thousand dollars under the U. S. Land Grant Act of 1890. The Faculty number seven Professors and Instructors. J. O. Crosby, PH. D. President.

PRAIRIE VIEW STATE NORMAL SCHOOL, HEMPSTEAD, TEXAS.

The act establishing this school as a State "Normal school for the preparation and training of colored teachers" became a law April 19th 1879. The school has been supported by liberal appropriations by the Legislature. The Normal course of study is like that of other normal schools with the exception that the languages are not taught.

The course of instruction has been enlarged from time to time as needs for such additions arose; special attention being given to such training as would tend to incline the pupils eventually to undertake teaching. In addition to this general purpose there are now four "departments" of the School, namely: "Industrial," "Mechanical," "Agricultural," and "Ladies Industrial," in which the endeavor is made to fit the pupil for employment in the higher industrial pursuits. The "Industrial Department" is, however, "subordinate to the Normal feature of the school."

All students "do practical work from one to two hours each day.

For the use of the Mechanical Department a work shop, 70x30 feet, has been built and equipped with thirty-eight separate sets of bench tools, three turning lathes, etc. An engine for running the machines is provided and a forge secured for giving instruction in blacksmithing.

For the Agricultural Department the school has 2,225 acres of land, of which one hundred acres are cultivated in farm and garden; there are, also, numerous pastures for stock. A branch of the U. S. Experiment Station is in charge of this Department.

In the Ladies Industrial Department, sewing, cooking, and all kinds of house work, are taught by special teachers. As in this department the chief purpose is to train teachers, "the Industrial features are kept subordinate to this aim."

"One student from each senatorial district and fifteen from the State at large will be admitted. These students will be maintained and taught free of charge." "All students, however, pay a matriculation fee of $5.00 and a medical fee of $2.00." "Pay students are charged for board $10.00 per month payable in advance." "No tuition is charged any one." All have the use of text books without charge. "No person under sixteen years of age will be admitted."

The above statements are taken from the latest catalogue at hand.* This shows a total attendance of 132, for the year 1889–90, 52 of whom were girls. Faculty and officers numbered 9, 3 of whom were women.

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*Annual Catalogue of the Prairie View State Normal School, for the school year 1889-90, with announcements for school sessions. Beginning September 4th, 1890. Hempstead, Texas. Houston, Texas: Dealy & Baker, Printers and Binders, 1890. Pp. 25.

When later this school was designated to receive the share of the income from the Government Grants coming to the colored people, the industrial features of necessity assumed greater importance.

From returns made to U. S. Bureau of Education for the year ending June 30th, 1893, a great increase in the teaching force is shown; the Faculty numbering 19, of whom 2 were women. There were 184 students, of whom 62 were girls.

L. C. Anderson, Principal.

West Virginia Colored Institute, Farm P. O., Kanawha County, West Va.*

This institution for the training of colored youth was the direct outcome of the passage by Congress of the act known as the "Supplementary Morrill" Law of 1890.

The Legislature of West Virginia by the act of 1891, incorporated this Institute and appropriated to it, from the national appropriation of $18,000, coming to the State, under the Law just referred to, the sum of $3,000; the remaining sum of $15,000 was given to the West Virginia University. This equitable division between the white and colored citizens was based on their relative ratio of numbers as shown by the census of population of school age. At the end of five years it was provided that the annual sum to be given to this Institute be increased to $5,000.

The Legislature made an additional appropriation of $10,000 for the purchase of a farm and erection of a suitable building. Thirty acres of level bottom land on the Great Kanawha river about eight miles below the city of Charleston, were purchased and a substantial three story brick building built; the corner stone of which was laid with much ceremony October 11th 1891. In April 1892 the completed building was accepted by the Board of Regents and "on May 3rd the Institute was formally opened in the presence of the honorable "Board" and an audience of over four hundred." Twenty students registered the first term.

At their next session the Legislature made a liberal appropriation of $14,000 for the equipment of the school and necessary improvements, in the matter of fencing and farm buildings. The machine shop was also adequately furnished with woodworking machinery at a cost of $4,000, and a blacksmith shop with four forges, put up. A "well chosen library of 500 volumes" is announced as open to the use of the students.

The present principal J. Edwin Campbell, PH. B., was chosen by the Board and took charge of the school April 1st 1892.

*The West Virginia Institute, State Agricultural, Mechanical and Normal College. Incorporated January, 1891. Opened May 3, 1892. Charleston: Moses W. Donnally, Public Printer 1893. Pp. 25.

These statements have been compiled from the Regents Report for 1892.

As at present organized three courses of Instruction; the Agricultural, the Mechanical, and the Normal, are provided. These courses are each of three years. There is also a Preparatory course of three years. Drawing is taught in the middle year of the Normal course and through each year of the Academic course. A course in Vocal Music continues through all the years of the Preparatory and Normal courses. Drawing is taught through the whole of the Mechanic course, with special reference to its practical applications. The Wood and Iron Work courses in Manual Training run through four years each. There is also a printing office in full operation with a two years' course in type setting and printing, and a class of twelve girls are setting type and publishing "The Owlet," the Institute Journal. Outside orders for both wood work and job printing are taken, and filled by the students.

The following is the programme of the Mechanical and Industrial courses, which are under direction of J. M. Canty, Jr., Professor of Mechanics, who has also charge of the military training of the students.

MANUAL TRAINING.

COURSE IN CARPENTRY.

FIRST YEAR. MACHINE WORK.

[Term 7 Weeks.]

First Term.—Name, proper care and use of tools and machinery. Adjustment of tools and machinery.

Second Term.— First term's work continued. Wood turning and machine boring, circular sawing, work on emery wheel, jig sawing.

Third Term.—Proper care and use of tools, and wood turning continued, planing, sharpening planer bits and knives on emery wheel and grindstone, filing and setting saws, belt cutting and lacing, band sawing, work on shaper.

Fourth Term.—Planing lumber and wood. Turning continued. Band sawing. Scroll work on jig and band saw. Mortising. Work on shaper.

Fifth Term.—Scroll work on jig and band saw continued. Planing. Tongue and grooving. Beading work on "universal wood worker," getting out molding and picture framing, etc. Belt cutting and lacing, mounting and speeding machinery. Machine carving. Lecture on year's work.

SECOND YEAR—BENCH WORK.

[Term 7 Weeks.]

First Term.—Proper care and use of tools, planing, joining, squaring, boring, dovetailing.

Second Term.—Miscellaneous.—Plumbing, proper care of boiler and engine, packing steam and hand pumps.

Third Term.—Miscellaneous.—Mixing paints, painting, making and using putty, making and using glue, preventing and warping lumber, preventing cracking of ends of lumber in kilns and dry houses.

Fourth Term.—Bench Work Resumed.—Pattern making for scroll work, picture framing, construction from sketch, repair work, cabinet work, cutting miters with and without miter box.

Fifth Term.—General review of and lectures on the year's work, awarding prizes for the best original designs of scroll work and framing for pictures and machine carving, outside work.

THIRD YEAR.

First Term.—Outside work and repairing, cabinet work, picture framing, hand bead and reading. Hand molding for pictures, frames, etc.

Second Term.—First term's work continued. Wood work for wagons, wheelbarrow making.

Third Term.—Work of first and second terms. Buggy and cart building.

Fourth Term.—This term will be given wholly to wagon, buggy and cabinet work.

Fifth Term.—Work of fourth term continued. Review of the year's work, strengthening defective points, lectures.

FOURTH YEAR.

First Term.—Cabinet, wagon, and buggy work continued from third year, hand carving.

Second Term.—Review of mounting and speeding machinery and adjustment of pulleys, increasing the capacity of machines, by original attachments, to do other work than that for which they were intended, hand carving.

Third Term.—Work from drawings, outside work, cabinet work, repairing furniture, house framing from drawings, house building, estimates, hand carving.

Fourth Term.—House building and framing continued, estimates, hand carving for furniture.

Fifth Term.—Review of fourth term's work. Prizes awarded for best hand carving, house designs and estimates. In this term the Senior class as a whole will do a piece of work as a representative of their mechanical skill, lectures on the year's work.

COURSE IN BLACKSMITHING.

FIRST YEAR.

[Term 7 Weeks.]

First Term.—Name, proper care and use of tools. Instruction in setting tune irons, striking and building fires for different forging.

Second Term.—Proper care and use of tools continued, regulating the blast for iron and steel welding, etc.

Third Term.—Filing, drilling, emery grinding, use of cold chisels, proper care and use of tools, properties and nature of metals.

Fourth Term.—Third term's work continued, thread cutting, grinding on emory wheel drills, chisels, brick punches etc., etc.

Fifth Term.—Repetition of fourth term's work, use of anvil tools without helper, lecture covering the year's work.

SECOND YEAR.

[Term 7 Weeks.]

First Term.—Use of anvil tools with helper, work from wood models, dressing and tempering anvil tools etc., etc.

Second Term.—Work of first term continued, dressing and tempering drills, simple repair work, welding iron.

Third Term.—Making drills, cold chisels, punches, callipers, screw drivers, "S" wrenches, etc., etc., simple repairing, welding iron and steel.

Fourth Term.—Work from drawings, welding iron and steel, jumps, "V" and scarf welds, setting irons to wood, putting work together.

Fifth Term.—Review of work of fourth term, welding iron and steel tires, principles of dishing wheels and setting tires, lecture on year's work.

THIRD YEAR.

First Term.—Horse shoeing, making anvil tools, repairing wagons and buggies, formula for tempering solutions, formula for welding compounds.

Second Term.—Horse shoeing and making anvil tools continued, forging parts for wagons, special attention to tempering.

Third Term.—Miscellaneous.—Hore shoeing, plumbing, proper care of boiler and engine, setting and speeding machinery, packing hand steam pumps, babbitting boxes.

Fourth Term.—Horse shoeing, wagon and buggy ironing, forging anvil and bench tools, dressing mill picks, stone cutter's tools, facing iron hammers, anvil tools, etc., with eteel.

Fifth Term.—Horse-shoeing, wagon and buggy ironing, dressing mill picks, stone cutter's tools, etc., continued from fourth term. Lectures on and review of the year's work.

FOURTH YEAR.

First Term.—Making mill picks, stone cutter's tools, mattocks, hoes, claw hammers, picks, wheelbarrow wheels (all iron), iron fencing, etc.

Second Term.—First term's work continued, making knives for planers, machine bits for molding, and beading carver's tools for hand and machine.

Third Term.—Review of first and second terms' work: Forging parts for machinery, repairing machinery, splicing iron, steel and cast-irons, making invisible seams.

Fourth Term.—Brazing band saws, etc., soldering, plating and review of babbitting.

Fifth Term.—In this term the seniors, as a class, will construct a piece of work, selected by the Professor of Mechanics, which will show their mechanical skill.

The senior class, individually, will do original work of their own selection and design. A prize will be awarded the students of this class for excellence.

COURSE IN PRINTING.

FIRST YEAR.

Type setting and distribution, study and use of treadle presses, correcting proof.

SECOND YEAR.

Type setting and distributing, making up of forms, proof reading, use of presses.

The young ladies in this department are already doing job work and publish each month an excellent little journal, The Owlet, devoted to the interests of the Institute.

DRAWING.

FIRST YEAR IN ACADEMIC DEPARTMENT.

[Term 7 Weeks.]

First Term.—Drawing (pencil) from plain geometric models.

Second Term.—Work of first term continued, with models united into other forms, etc.

Third Term.—Second term's work continued.
Fourth Term.—Drawing from casts, sketching simple studies from nature.
Fifth Term.—Work of previous term continued.

SECOND YEAR.

First Term.—Previous term continued, mechanical drawing in class room. Work continued through the year

THIRD YEAR.

Original designing for the shops.

NOTE—The third year, work in crayon, and pastel portraiture may be taken at option.; stump work occupying the entire first term.

Tuition is free, except a matriculation fee of one dollar each term.

Board is not more than seven dollars per month.

The list of students shows an attendance of 40, 39 in the Preparatory Department and 1 in the Academic; 24 take the "Agricultural and Mechanical" courses and 30 the "Normal and Industrial," 17 names being repeated as in both divisions. From the list of names the sexes seem about equal in number, with apparently a slight excess of boys, but this is uncertain as some of the first names give no clue to the sex of their bearers. The teaching force numbers seven; six Professors and Instructors and one Practical Farmer. J. Edwin Campbell, PH. B., Principal and Professor of Mathematics.

APPENDICES.

APPENDICES.

GENERAL INTRODUCTION.

The present volume of this Report being given to accounts of the Institutions of Technical Training in the United States, including the Mechanical and Technical Departments of the National Land Grant Colleges of Agriculture and the Mechanic Arts, the Appendices which here follow are composed of papers relating more or less directly to these several classes of institutions.

As each Appendix, and often each paper, is accompanied by a few explanatory words of introduction, only a brief summary of the several appendices seems here desirable.

These appendices begin with Appendix "X," which is entitled "Technical Education in the United States with instances of similar efforts in European countries;" and comprises, first: The addresses delivered on the occasion of the opening, in 1883, of the high class mechanical school, then known as "The Terre Haute School of Industrial Science," later renamed "The Rose Polytechnic Institute," which is the second, in date of its opening, among such schools in the United States; the first having been "The Worcester County Free Institute of Industrial Science" founded by John Boynton, in 1865, and opened in 1868; now known as "The Worcester Polytechnic Institute," situated at Worcester, Massachusetts.

The Terre Haute school—endowed by the single public spirited citizen, Chauncey Rose, whose name it now commemorates—was the direct outcome and result of the success of the Pioneer school of this class in America, just referred to.

The directors of the new institution had wisely secured to launch their new enterprise, the aid of the man who had achieved distinguished success in the management of the Worcester school.

President Thompson, took for the subject of his Inaugural Address "The Modern Polytechnic School." A topic which he was peculiarly fitted to develop owing to his long experience as Director of the Worcester School, supplemented by two journeys of observation in Europe, undertaken by him for the express purpose of investigating institutions of Technical Education. This important contribution to the literature of the Modern Educational Movement is given in full. For the account of the Institution so admirably inaugurated and of the cutting short of President Thompson's brilliant career, in the very fullness of his powers, by his sudden decease in March, 1885, the reader is referred to page 184, *et seq.*, of this volume.

Dr. Thompson, was followed in the presidency of the Worcester school, by Dr. H. T. Fuller, parts of whose Inaugural Address, delivered June 28th, 1883, and entitled "The Present Place and Work of

Technical Schools," are given as the final paper of this Appendix. This address gives a concise statement of the origin, progress and present status of Institutions of Technical Industrial Training on the Continent of Europe.

The inter relations between the Rose and Worcester Polytechnic Schools, have been again illustrated by the calling, in 1894, of Professor Mendenhall—who followed the lamented President Thompson, as President of "The Rose Polytechnic," and who was called from there to Washington to preside over the U. S. Coast and Geodetic Survey—to assume the Presidency of The Worcester Polytechnic Institute.

Appendix "Y", consists of an account of an interesting experiment of a special technical school undertaken by the officials of the Baltimore and Ohio Railroad Company in connection with their shops at the Mt. Clare station, near the city of Baltimore, Maryland.

This school, owing to changes in the directory of the company, was so soon abandoned that it would hardly have here received more than a brief mention were it not for the very valuable "Report" on the whole subject of "Technical Industrial Education," made under the direction of the late Dr. W. T. Barnard, assistant to President Garrett, which is, in itself, a valuable contribution to the literature of this modern movement in education, and as such, is here inserted.

Appendix "Z," comprises "Papers relating to the U. S. Colleges of Agriculture and the Mechanic Arts." These include, first: Copies of the three Laws of the United States conveying grants to these institutions; popularly known as "The Morrill Act of 1862," "The Hatch Act of 1888," and "The supplementary Morrill Act of 1890." The second paper consists of very interesting historical statements showing the active part taken by the late Dr. Amos Brown, of New York State, and the late Dr. Evan Pugh, of Pennsylvania, in aiding the passage of the first of the just mentioned U. S. Land Grant Laws in favor of the new education.

An interesting paper follows, on "Agricultural Education in Bavaria," by Professor R. B. Warder.

Then comes the address, giving a clear setting forth of the character and purpose of this new movement in education, with which Professor Hamilton dignified the opening, in 1886, of the new Mechanical Department Building of the Pennsylvania State College.

This Appendix is closed by the farewell address by Bishop Haygood, delivered in 1890, at the commencement of Claflin University, at Orangeburg, South Carolina. In this address the Bishop opens up the whole subject of Technical Industrial Training in its relation to the colored youth in the United States.

Appendix "A.A.," comprises "Papers relating to Technical Education in England" and consists of addresses, and articles from the Press, which illustrate the active and intelligent interest taken by the ruling authorities of Great Britain, in every phase of the industrial development of the people. These papers include among others, reports of addresses by President Dawson, by the Lord Chancellor and by the Prince of Wales.

Appendix "B.B.," comprises "Papers Relating to Technical Art Training in England." These include a leader from the Times, on the address by Lord Hartington; an article from the Westminster Review, showing the need of Technical Training in England, in view of the trade competition of Continental Europe; also, an address by Professor Huxley.

APPENDIX X.

PAPERS RELATING TO TECHNICAL EDUCATION IN THE UNITED STATES; WITH INSTANCES OF SIMILAR EFFORTS IN EUROPEAN COUNTRIES.

I. Introduction.

II. Inaugural exercises, with report of various addresses, delivered at the forma opening of Rose Polytechnic Institute, Terre Haute, Indiana, in 1883.

III. Inaugural Address by President C. O. Thompson, entitled: "Rose Polytechnic Institute and The Modern Polytechnic School."

IV. Inaugural Address by President Homer T. Fuller, Ph. D., Worcester Fre Institute, Worcester, Massachusetts, in 1883.

APPENDIX X.

TECHNICAL EDUCATION IN THE UNITED STATES; WITH INSTANCES OF SIMILAR EFFORTS IN EUROPEAN COUNTRIES.

I.

Introduction.

One of the earliest established and most important of the new Schools of Science, is that of the Rose Polytechnic Institute, founded at Terre Haute, Indiana, by the munificence of the late Chauncey Rose, who organized the Board of Trustees and witnessed the laying the corner stone of the edifice; but whose death preceded by some years the actual opening of the Institute, which took place March 7th, 1883.

President Charles O. Thompson, who had for many years successfully presided over The Worcester Free Institute of Science, was early selected as President of the new Institution, and visited Europe in its interest, to see what were the latest methods adopted in European schools of a similar character; with the purpose of securing for the new school of which he was to have charge, whatever was most desirable in apparatus or methods.

In the extracts from his inaugural address on "The Modern Polytechnic School," it will be observed that President Thompson begins with a clear definition of what Technology is, and with a philosophical statement of its origin and its province.

In doing this he happily discriminates between, and defines, the other forms of artistic and mechanical industrial education, generally somewhat confusedly grouped under the comprehensive term of "Technical Training,"—he then gives a brief outline of what a School of Technology proper should teach, and, by instituting comparisons between the Worcester methods and those of the leading European schools, makes a very clear exposition of the principles in accordance with which the Rose Polytechnic Institute is to be developed.

President Thompson calls attention to the impressive fact that most of the notable institutions of this class have been founded by private generosity; this, as we have previously noted, has also been the case with many of the classical universities and colleges.

When President Thompson left Worcester, Dr. Homer T. Fuller, was called to succeed him. The following extracts from Dr. Fuller's inaugural address, delivered June 28th, 1883, give a succinct history of the founding of technical schools abroad; with very interesting comparisons of their rapid development as observed by him in his two visits, made three years apart.

II.

Addresses delivered on the occasion of the opening of The Rose Polytechnic Institute*, March 7th, 1883.

The formal public opening of The Rose Polytechnic Institute, at Terre Haute, Indiana, was a notable event; memorable not only because it was the inauguration of the second school of its class in the United States, and in thus receiving the approval of the distinguished educators who had assembled to do honor to the occasion, gave evidence that the pioneer school in Worcester, Massachusetts, opened in 1868, had demonstrated the value of the combination of an engineering school and a practical workshop, which is the peculiar feature of this class of educational institutions; but, also, because, in his Inaugural Address, President Thompson, the inventor of this form of school, gave an historical survey of the rise and progress of Technological Education, with an analysis of the methods adopted by him in his first experiment, the Worcester School, and indicated the modification of the Worcester plan which he sought to introduce in the Rose Polytechnic Institute.

When it is recalled that Dr. Thompson, before he began at Worcester, had made a careful personal investigation of the leading schools of Science and Technology in America and Europe; and, again, subsequent to his years of experience in Worcester, had made a similar tour of inspection at home and abroad, in preparation for the establishment of this new Institute which he had been called to create, the permanent value of such a deliberate exposition of these methods of technical Training can hardly be questioned. The address of the late President Thompson, is, therefore, here given in full. Some twenty-nine pages of the memorial pamphlet which contains this address, are given to the addresses which preceded it,—in which, touching tributes are paid to the late Chauncey Rose, the Founder of the Institute, and a cordial and appreciative welcome is extended to President Thompson. Extracts from these addresses are given. The account of the Institute itself will be found on pages 194–201 of this volume.

Inaugural Exercises.

Arrangements for the inauguration were made by Gen. Charles Cruft and Messrs. William Mack and Robert S. Cox, a committee appointed for the purpose. On Wednesday, March 7th, 1883, at 10 o'clock A. M., the ceremonies were held, in the chapel of the Institute, in the presence of one of the largest audiences ever assembled in the city of Terre Haute. The stage and auditorium of the chapel were crowded to overflowing, and a multitude filled the halls and corridors of the academic building. The stage and the speakers' stand were beautifully decorated with flowers and potted plants, contributed by Mrs. Sarah A. Heminway, a cousin of Mr. Rose, and, for many of the declining years of his life, the head of his family. On the President's table an exquisite floral ornament represented the taste and liberality of Mr. Firmin Nippert, and at the extreme right of the platform, a fine India ink portrait of Mr. Rose, executed by Brady, of New York, was wreathed with garlands of smilax.

The stage was occupied by the Board of Managers, the Faculty of the Institute, the speakers of the day, a number of the leading educators of the State, and many

*Rose Polytechnic Institute. Addresses of Inauguration and Dedication, with memorial notices, a historical introduction, and First Annual Catalogue. Terre Haute, Ind: G. W. Broun, Printer and binder, 1883, Pp. 84.

prominent citizens of Indiana and other States. Among them were Hon. R. W Thompson, LL.D., and Gen. John Eaton, United States Commissioner of Educa tion, who were the invited speakers; Prof. John M. Bloss, Superintendent of Publi Instruction; Hons. George I. Reed, Murray Briggs, Joseph Gilbert, and Barnaba C. Hobbs, LL.D., of the State Normal School Board; President Lemuel Moss, o the State University; President Emerson E. White, of Purdue University; Mayo Jas. B. Lyne, of Terre Haute; Hon. John E. Lamb, M. C.; Monsieur Louis Genis Ing. Civ., and *Élève* of the Royal Polytechnic School of Belgium; John R. Elder of Indianapolis, formerly one of the Normal Trustees; President George P. Brow and Prof. E. F. Brown, of the Normal Faculty; Superintendent Wiley, Prof Byers and Prof. Donaldson, of the city school staff; R. A. Morris and J. W. Lan drum, City School Trustees; John F. Roedel, John DeBaun, and John Wilson County Commissioners; Hon. W. R. McKeen, and Prof. J. H. Cooper, Superintend ent of the Evansville Public Schools.

Promptly at the appointed hour, President Josephus Collett, of the Board of Mana gers, who presided on the occasion, called the assemblage to order, and the exercise began with music by Prof. Breinig's orchestra, after which prayer was offered b Rev. C. Pitman Croft, Pastor of the First Congregational Church:

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Address by Hon. R. W. Thompson.

The President then introduced Hon. R. W. Thompson, who delivered the follow ing address:

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This institution is destined to fill a place hitherto unoccupied in this State and i the West. It should be viewed, therefore, with especial favor and pride by the citi zens of this city, not only because it will become the central point from which valuabl educational influences are expected to radiate, but because it had its origin in th mind of one of our most eminent citizens, and is so endowed by his magnificent lib erality as to insure its complete success. We can not do too much honor to th memory of a man who, with unsurpassed liberality, rounded off a long life o assiduous industry by devoting his wealth to this and other benevolent enterprises calculated to benefit society, alleviate suffering, and give fresh impulse to ennoblin thoughts.

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There is, therefore, no antagonism or room for it, between existing educationa institutions and a polytechnic school like this. They belong to the same family draw inspiration from the same fountain, and should dwell together in concor around the same altar. They are twin sisters. Technology does not repudiate th abstract sciences. On the contrary, it recognizes their demonstrations and applie their truths. It takes them up at the point where they have reached their highes theoretical development, and causes them to serve practical and indispensabl uses—to the production of results which would otherwise remain unknown. It i such an auxiliary as the abstract sciences should seek after, so that, neither repel ling the other, the two should constitute a harmonious whole. And it is becaus this feature in our system of education will be exhibited in the progress of thi institution, that it commends itself, in an eminent degree, to the public approbation The public need the existence of such a school, and are to be congratulated upon it establishment under existing auspices. In view of its origin, its location, the char acter of our people, the sagacity of its managers, and the eminent fitness of it faculty, I may be allowed to say, as we sometimes do of individuals, that it is th right school in the right place.

WHAT POLYTECHNIC SCHOOLS HAVE EFFECTED IN EUROPE.

Why may we not assure to ourselves the advantages which others have enjoye from technological teaching in polytechnic schools? France, under whose nationa auspices they were first established, less than a century ago, with a view chiefly to th education of civil and military engineers, has been greatly benefitted by them. The have enabled her engineers to occupy positions in the front rank among the mos distinguished in the world. These, by thorough explorations, have succeeded i mapping out with great particularity, all her material and natural resources. B this means, and by the scientific classification of her soils, and her mineral an vegetable products, she has been enabled to understand the nature and extent o her own resources, and to shape her policies and industries so as to develop them t the utmost. Her wonderful success in this is seen in the facts that wealth and th means of subsistence are more equally distributed in France than in any other Euro

pean state, and that almost every foot of earth is made to contribute to the prosperity of a people to whom emigration is not necessary, as in neighboring nations, in order to better their material condition.

Our natural resources are many hundred fold in excess of those of France. One only of our states, ont of thirty-eight, contains 70,000 square miles more of territory, and our whole area is more than seventeen times greater. There is not a single natural product to be found within the degrees of latitude that mark our extent which we do not possess. They are scattered about in every direction in rich profusion—here, there, and everywhere. Already has their development astonished the world, and ourselves also; and what we shall need in the future is to see that nothing shall occur to arrest or check it, but, on the contrary, that everything shall be done to accelerate its progress.

We have occupations enough for all—fields of adventure and enterprise widening out every day—inducements for the employment of our best energies and our most ennobling faculties. Our whole population is thirsting for knowedge, in all the varieties of its forms. They read more books, and magazines, and newspapers, than any other people. These great educators are tireless in the work of enlightenment, and he who does not learn someting every day may well exclaim, like the Roman Emperor, "*perdidi diem*—" I have lost a day! Our young men are standing ready, with the courage of veteran soldiers, panting to leap to the front whensoever any adversary to our progress, material or intellectual, shall appear. They have the right to demand that those of us who are passing away, and whose places they will soon fill, that we shall not withhold from them the proper weapons with which to carry on the battle of life—a battle that will require all the courage and fortitude they can command.

Among the weapons for this conflict none are so effective in the production of good results as enlightened intelligence, which enables its possessor to appreciate the character and importance of passing events, and to derive wisdom from their teachings.

It was thus that the founder of this institution reasoned in his lifetime. He was anxious that the young men of this state, and especially those of this vicinity, should not fall behind in any sphere of duty to which they might be called. And, desiring them to perform their share in the great work of the future, he established this school as the means of enabling them to do it manfully and well. It is a gift to the country, and a legacy to them, worth more than gold. It is a priceless inheritance. Who can measure the extent of the good it is destined to accomplish? Who can tell what shall be the extent of its contributions towards such a material development of this country as shall compare with that produced, by like means, in France? We know now that its first steps are well taken, and in the right direction towards complete success; and the character and qualities of those who manage its affairs, give the best assurance that this success will be won. Then, if it shall be allowed by Providence that the spirit of its generous founder shall look back upon the scenes of this life, his immortal soul will exult at the thought that his methods of diffusing beneficent influences amongst men were well conceived, and have been faithfully executed.

Memorial Notice of Chauncey Rose.

It is appropriate to this occasion that I add a few words with special reference to Chauncey Rose, without whose generous-hearted liberality these ceremonies could not have transpired. Like a few others in this audience, my personal intercourse with him embraced a period of more than the third of a century. During this time I had many opportunities to observe his leading characteristics, and to become familiar with the structure of his mind and the tendency of his thoughts. He was emphatically self-made, and owed nothing to the mere adventitious circumstances of life. Having commenced life without the favors of fortune, one of the first lessons he learned was self-reliance, from which grew that indomitable courage which constituted one of the most conspicuous elements of his character. His character, therefore, was his own creation, and was well and symmetrically built up. It was moulded in an important degree by the incidents of a frontier life with which he participated. He became a citizen of this country about two years after the state constitution was formed, and the year in which this city was selected as the county seat. The population, at that time, was very small, and I know of but two now living in Terre Haute who were then here. The fact that he sought the adventure of a country entirely new, and was willing to contend against its hardships, which were numerous and scarcely conceived of by the present population, was proof that he was courageous. He had many occasions, in the course of a long life, to exhibit this quality, and I am quite sure that, upon none of them, was he ever known to fall below its requirements. I do not mean mere animal courage,

but that of a higher and nobler type—such as is the product of honest and intelligent convictions. This may be justly said to have been the base upon which the whole structure of his character was built, and it enabled him, upon all occasions of business or social intercourse, to impress his thoughts and opinions upon others. It was impossible not to see that he believed and meant what he said, and that his whole conduct was the result of honest conviction. This was, undoubtedly, the case with him, so conspicuously and to such a degree, that even those who did not agree with him, were ready to concede that whatsoever opinions he expressed were honestly entertained. And thus it was that he acquired a reputation for integrity upon which no aspersions were ever cast.

In his business transactions he always displayed great sagacity, and was scrupulously exact. His mind was well balanced, and his judgment generally accurate, both as regarded men and things. He read a good deal, and was a careful observer of passing events, which he analyzed with great thoroughness. He was, therefore, among the earliest of those who foresaw the growth and prosperity of this city and county, and, indeed, of the state.

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He acquired the reputation of being what is popularly called a "railroad king," and if to have been one of the foremost and most conspicuous among the pioneer advocates of that kind of improvement entitled him to be so known, the title was properly given him.

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He took deep interest in the cause of education generally. But that kind of education most suitable for young men of genius, talents and enterprise, and which should fit them for the highest spheres of practical life, was, with him, a favorite topic of thought and conversation. His leading idea was that a system should be provided that would blend the industrial sciences with the branches of knowledge usually taught in the schools and colleges, so that the pupils should not only become scholars in the ordinary sense, but should be enabled to follow the various mechanical, professional, and industrial pursuits with intelligence and skill. He desired to build up a class of educated and scientific mechanics and laboring men, so that, in the pursuit of their various vocations, they should be able to give full scope to their inventive and constructive talents. In furtherance of his general purpose he gave, from time to time, liberal contributions to Wabash College, at Crawfordsville. He also furnished the means of adding essentially to the library of the State Normal School, in this city; and paid the expenses of a considerable number of young ladies while fitting themselves at that school to become teachers. And at last, his leading and long cherished thought with reference to education, culminated in the grand and noble bequest which has caused the erection of this building and the establishment of this polytechnic school. His various gifts in this vicinity and State, for these philanthropic purposes, exceed a million of dollars.

Few men have left so many evidences of a humane and philanthropic spirit, or have bestowed their charities more wisely. There is an entire absence of anything like selfishness in each one of them, and so quietly were many of them dispensed that the public knew nothing of them until their fruits were observed. As his own conscience guided him, and he needed nothing more than its approval, he did not seek after notoriety, or what the world calls fame. As it was impossible to shake his purpose when it became fixed, so it was always executed without regard to mere applause. As he deliberated well and intelligently before acting, and followed the counsel of his own convictions, so he left his acts to speak for themselves, as they now do with eloquence which no words can imitate.

The many who have already been relieved by his benevolence will unite in the bestowal of blessings upon his memory. Hundreds of others yet to come, who shall share the benefactions he has so bountifully provided, will repeat his name with sincere and heartfelt praises. But there will be none louder or more earnest in this than the recipients of the blessings which shall flow from this school, whose foundations he has laid with so much wisdom and foresight, and around which his affections clustered with the most intense ardor of his nature.

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Remarks by General John Eaton, U. S. Commissioner of Education.

General John Eaton, United States Commissioner of Education, having been presented to the audience by the President, spoke as follows:

This occasion is a striking illustration of the characteristics of American freedom and civilization. How often, in other forms of government, imperial or monarchical, only members of the royal or aristocratic families are expected to make

benefactions for the welfare of the people. Tyndall, even, has expressed a fear that America would come short in the race of scientific research because of lack of royal patronage.

An intelligent European traveling among us was so struck with the great endowments of which he learned, and the magnificent buildings erected by private persons for educational purposes, that he gathered the best information and illustrations of some of the most conspicuous instances, and arranged them for the benefit of his friends in his store in the old city of Prague, that those seeing them might not wait for royalty, but go themselves and do likewise.

Mr. Rose was a man of the people; he gained his wealth by those methods of honest toil, by that self-denying, persistent application which it is the peculiar distinction of our free institutions to warmly encourage and generously reward. Gaining wealth, he did not coin his soul into money. He preserved his humanity; he was touched by the condition of his fellows. Visiting among strangers in New York City an institution for ruptured and crippled children, he felt their needs, and gave in all for their benefit one hundred thousand dollars. He won his way by toil. His penetration saw the relation of thought to action, of science to labor, of culture to human welfare. He may not have been able to state all the postulates that unfold the effect of education upon handicraft, but he so far apprehended their meaning that he gave funds for this institute of technology, that the honest life efforts of the young who come here may not be burdened and crippled and circumscribed by ignorance. He would offer them here opportunities to gain a power more subtle and effective than that of Aladdin, with which to master difficulties and make nature contribute to their progress, usefulness, comfort and pleasure.

Those intrusted with the execution of his purpose have sought to adopt the wisest means to find out the right way. They have made haste slowly. The problems upon whose solution his great purpose depends for success are not all solved. The two great worlds of capital and labor, so often in danger of arraying themselves in conflict, are bringing all the forces at command for their solution. These considerate officers have sought to take advantage of what has been done. They have selected for President one well known for his capacity, alike for broad and precise scholarship and successful administration, who has brought a similar institution from its first planting to a high degree of merited success, and before putting his hand to the work here has taken time to visit and study again the conditions of educational progress, general and special, in its great centres and most instructive aspects in Great Britain and on the continent of Europe.

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In the United States a large portion of our people have been engaged in the struggles of pioneer life. The church and the school house have been conspicuous side by side in their settlements. The school master has been abroad in the common school. The increase of books and newspapers has been marvelous. The discharge of the duty of citizenship and of the manifold voluntary associations promotive of social and individual welfare in addition to the efforts for self-support, have had a marked and healthful educating influence.

The chances for wealth have been rewarded with remarkable success, and have been sought by the citizens of every civilized nation. Among these newcomers to our shores are many who have received the training of schools of technology and of the arts and trades. These scientists and experts have contributed enormously to the development of our interests and the advance of American scholarship and literature.

Some years since, in connection with an effort to overthrow the high school in one of our largest manufacturing cities, an inquiry revealed the fact that the foreman in each of the large manufacturing establishments had enjoyed the advantage of skilled training in a foreign land.

The conditions which have led to the establishment of special schools in other lands are becoming apparent in our own.

Educators and benefactors have united in their establishment and efficient conduct. The old colleges have admitted scientific departments. Harvard, the Lawrence Scientific School; Yale, the Sheffield; Dartmouth, the Chandler. The natural sciences have been given larger space in the curriculum of all colleges. General culture has been brought into closer relations with the struggles of life; but more has been demanded.

THE U. S. LAND GRANT LAWS.

In 1862 the Congress of the United States made a grant of lands from the public domain for the establishment of colleges of agriculture and the mechanic arts, and these institutions have been accordingly established in all the states, except one, and are now doing good work. Often and often they have been declared failures by those who did not know the facts.

It should be observed that there were no institutions established to fit young persons to enter these colleges of agriculture and mechanic arts. All fitting schools aimed to prepare their students for classical courses. Moreover, our farmers had not in sufficient numbers come to appreciate the application of scientific information and training to their great industry, and were not ready to compensate sufficiently the graduates of these institutions to warrant them in devoting their lives to the tilling of the soil. Our educated youth cannot be blamed for turning their efforts in the direction of the greatest success. But changes have come rapidly. In addition to these institutions, in which more attention is expected to be given to technology, science and industry, many others have been established and sustained by private endowments, and these have been adding their graduates, specially qualified in the various departments of engineering and mechanic arts. Already a larger number trained in these state and private institutions are demanded by those who wish to apply science to agriculture. They are called for as foremen in the manifold manufacturing establishments; they are directing the enormous capital invested in mining; they are surveying our rivers and harbors, our coasts, our undeveloped lands, and marking out the ways for our great railroad enterprises. It is gratifying to know that the demand is greater than the supply. The Polytechnic school has its own work to do in this community and this state. We have passed the time of frontier life, rude, vigorous and poor. We have a great population, a various industry, enormous natural resources to use wisely and provide for shrewdly. The loneliness, the privations, the dangers of early times, are gone with the free land, the forest, the deer and the panther; the frontiers of our speech and our civilization are now at the Rio Grande and the Athabasca. The work of four generations has made the Ohio valley and the Lake region more populous, more accessible, more rich than all the thirteen colonies that fringed the Atlantic coast a century ago.

THE NEW DEMANDS MADE BY THE PRESENT AGE.

Our wants, our tastes, our objects have changed as much as the circumstances of our life. We wish for comfort as well as shelter, for tasteful as much as warm apparel, for various as well as sufficient food, for mental as much as bodily nutriment. The defective, dependent and delinquent classes of our population are better fed, lodged, clothed and instructed than the pioneers of the old time. The soil must produce more and better food, without losing fertility; the earth must yield its coal, iron, lead and copper for the arts of peace and the uses of war. The waters must bear craft of which our forefathers never dreamed, and must be curbed so that the fields and homes of our people shall not be submerged; the electric fluid must carry, not only the verbal, but the oral messages of our intercourse. The waste, the ignorance, the carelessness of the past are doomed. The problem for the new age is to perfect every appliance for man's progress over land and wave, his comfort as well as his necessities, his enjoyment as well as his life.

The common advance in economy, precision and importance which improvements in machine construction have made manifest in that branch of industry, must be sought for in other branches of work and life. Our trades, our farm work, our buildings, our vehicles, our vessels, must be equally developed and perfected; and our tastes, our minds, our bodies and our souls must not be neglected. The graces of life, the amenities of manner, the beauties of art and nature must be cultivated as sedulously as corn, and bred more carefully than sheep and horses. Not men only are required for this work. Already women have had a share in the increase of opportunities. The normal schools, especially, have opened to them new careers as successful teachers, and biological, chemical and scientific laboratories are offering to them the same opportunities for excellence as to men.

THE ROSE POLYTECHNIC IS TO BE A MODERN SCHOOL OF TECHNOLOGY.

The Rose Polytechnic Institute to-day takes its place in this array of great schools of science, technology and industry. It has wrapped up in its plans untold blessings for the community in which it is established. It is one of a trio of somewhat similar institutions, Purdue University and the University of Illinois, which together with itself may be said to stand at the angles of a limited triangle whose lines may draw them into a proximity calculated to awaken the sensitiveness of some minds, but each of these institutions in its local approaches can only create a healthy emulation. Each and all are under national demands to do their utmost, not alone to learning, to science, to the arts and trades, and citizenship, but to general education. I have alluded to the effect of establishing the Kensington museum and technical and industrial schools upon elementary education in England. Our educators are recognizing a similar necessity in this country. Teachers are needed who under-

stand more of arts and trades. The intelligent public mind in America is struggling with this problem of how to adapt the common school education to the changing needs of industry and society.

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If I thought to add another remark, I wish I could convey to you some idea of the activity manifest to one in the Bureau of Education at Washington, that national clearing house of educational information upon the instruction to be imparted in these institutions. Germany, with all its previous attempts in this direction, has just had a special commission traveling to gain information on this subject. There is enormous activity in France; even Spain and Russia are bringing institutions of this class to the very forefront of excellence. England has had a learned commission thoroughly investigating the subject upon the Continent; her colonies in North America and in distant seas have been making the same inquiry.

The many demands at Washington have prompted the Senate to call for a special report on industrial education in the United States. The Bureau of Education seeking according to the measure of its means to answer these demands, has printed the preliminary report of the English commission and has issued a small circular on instruction in the minor arts, for which a single mail brought requests for over six thousand copies. Another extended report is in progress on drawing and instruction in art.

The persons among us who are making this subject a special study are as yet unnumbered. Every philanthropic and patriotic impulse of our natures prompts us as Americans to desire that the problems committed to this and all other institutions of learning in our land may be solved without the necessity of blows and violence.

THE LESSON OF THE GERMAN HELMET IN THE FRENCH MUSEUM.

You may remember the story that Prof. Roscoe told of a visit to a technological school in the French city of Rouen, where he was shown a museum of natural objects. The Englishman saw among the articles a German helmet, and asked, "Do you call that a natural object?" "No," said the French director, "but it plays a very important part in our teaching. When our young men seem lax and indifferent I put this helmet on the table before them and say, 'Gentlemen, look at that helmet; you know how it came here; you know that the wearers of those helmets stripped France of her fairest provinces from the Alps to the British channel, and humiliated us in our city of Rouen. You know also that they were able to do these things because they were more intelligent than we Frenchmen were. Do you wish them to do it again?' Nothing quickens the industry of my students as that helmet does."

Friends of Rose Institute, may you never need to remember any victory in your own territory over yourselves—whether in arts or in arms, gained by others, because of your ignorance. May your children ever find the highest stimulus to application, not in disgrace, but in the wisdom and success of their fathers.

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Dr. Lemuel Moss, President of the State University, was called upon by President Collett for an address, and responded briefly. Dr. Moss not having been able, owing to the pressure of his engagements, to comply with the request of the Board that he should furnish a report of his remarks, it is impossible to present them as delivered. They were a notable episode of the ceremonies, and, in the characteristically eloquent manner of the distinguished speaker, recognized the new institution as an important addition to the educational forces of the state, extended the heartiest and most cordial welcome to Dr. Thompson, President-elect of the Faculty, and paid a glorious tribute to the far-sighted and practical benevolence of the generous founder.

ADDRESS BY PRESIDENT E. E. WHITE OF PURDUE UNIVERSITY.

The President then introduced Dr. Emerson E. White, President of Purdue University, who said:

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While I should much have enjoyed the privilege of being a silent listener, the occasion makes speech easy, since it affords me an opportunity to welcome to Indiana my friend, Dr. Charles O. Thompson, who this day assumes the direction of one of the most important educational enterprises in the West. He comes here to try no new experiment, but to organize and direct an institution all the elements of whose success are familiar to him—he comes an organizer, who sees the end from the beginning. I join most heartily with President Moss in welcoming so distinguished a representative of higher technical education to this noble commonwealth, whose

vast industrial resources are waiting for the touch of technical science and skill to turn them into fabulous wealth. I have watched the work of Dr. Thompson for years, and his acceptancy of the presidency of this important technical institution, is, to my mind, a full assurance of its success. I stand in this presence as the representative of Purdue University, an institution founded by Congress for the benefit of agriculture and the mechanic arts, and I assume no prophetic forecast when I express the belief that there is to be no unpleasant rivalry between the two institutions. The success of Rose Polytechnic Institute will emphasize the practical importance of technical training, and it will thus create a wider appreciation of the special work for which Purdue University was founded. It is true that Purdue covers a wider field of technical training, but, in this case, whatever strengthens a part will strengthen the whole. The better the technical training here the better the industrial work at Lafayette. Purdue welcomes her worthy co-worker in the field of industrial education, and she extends most hearty congratulations that the opening to-day is so auspicious and so full of promise.

THE TECHNICAL SCHOOL A PRIME FACTOR IN THE RETENTION OF AMERICAN POWER.

The American people are at last awakening to the importance of technical training, so universally recognized in the older countries of Europe. Seven years ago, when I went to Purdue, there was little demand for agricultural or mechanical education in this state, and, though the present appreciation of such training is far from satisfactory, the change wrought in these seven years is full of encouragement, the most significant evidence of this change being the founding of this great technical school by private munificence.

It is becoming more and more evident that the railroad, the steamship and the telegraph have destroyed our industrial isolation, and that the American artisan must successfully compete with European workmen in skill or retire from the shop and surrender the market. The day of mere muscle in industry has passed and the day of mind, with skill of eye and hand, has dawned. It may be well for a time to put legal barriers between American industry and foreign competition, but in the end we must depend on equal technical knowledge and skill. What our vast resources most need is the touch of science and technical power, and hence the technical school is the prime factor in the problem of American industry. This is the great industrial lesson which the people of this country are beginning to learn—and not a day too soon. Thought in the brain of the workmen has been the source of our marvelous material development. It has been the parent of invention which has already wrought a revolution in nearly all departments of human industry.

OLD AND MODERN FARMING TOOLS COMPARED.

Forty years ago the father and his sons, with sickle in hand, filed into the wheat field and handful by handful laid it in sheaves. A thoughtful reaper, with aching back, asked himself the question, "Why can not I give my fingers to my scythe?" The answer was the invention of the old square-cornered cradle, with which the harvest hand could cut two acres of grain with less weariness than he had cut a half acre with a sickle. Another thinking workman, with aching arm, asked himself the question, "What is the use of so much timber?" and he rounded the corner, inventing the "muly" cradle with which the harvester could cut half an acre of grain more daily and with less weariness than before.

But the sickle long since disappeared from the harvest field, and is now kept only as a relic of other days; the old square-cornered cradle hangs on a dying peach tree with a single finger left; and the "muly" cradle is only kept to pick up lodged places and cut out corners. When the harvest waves its golden welcome to the joyous farmer, out from the stable come fat horses, and attached to wondrous reaper and self-binder, round and round the field they go, leaving the grain in well bound sheaves. Here is progress in farming as the industrial result of thought power. Thought in the brain of labor is the alchemy that is turning everything it touches into gold.

PRESENTATION OF THE KEYS TO THE NEW PRESIDENT.

After Dr. White's remarks, President Collett presented the keys of the Institute to Dr. Charles O. Thompson, President of the Faculty, in the following terms:

Professor Thompson: In selecting a President of the Rose Polytechnic Institute the managers were impressed with the importance and delicacy of the duty devolving upon them. The question as to whether the Institute were to be successful and meet the expectations of its founder, or prove a source of disappointment to its friends, depended largely upon the wisdom of their choice.

The matter was long and carefully considered, and every effort made to secure the fullest information as to the fitness of the persons suggested for the position. Their unanimous choice has fallen upon you, and they deem themselves fortunate in having secured your services, believing that the Institute will be safe in your hands, and its prosperity and usefulness fully assured.

On behalf of the Board of Managers I tender you the keys of the Institute.

On receiving the keys, Dr. Thompson, in a few brief *ex-tempore* sentences, thanked the Board of Managers for their expression of confidence and pledged his best efforts to secure the success of the school. He then proceeded to the delivery of his inaugural address.

III.

Dr. Thompson's Inaugural Address.

The Rose Polytechnic Institute is a school of technology. In order to understand the functions of the school it is necessary to take a brief survey of the field of technical training. This phrase describes all those forms of training youth which deal with the application of art or of science to the industrial arts. Those schools in which designing for the patterns of textile fabrics, or for the decoration of wood, iron, pottery, gems, etc., is the principal end, are called art schools, or schools of design, of which the South Kensington system is the most famous example; all those in which the principles of physical science are studied with reference to their application to the solution of practical problems in building, machine construction, and design, or in civil engineering, are called polytechnic or technological schools. There is great confusion just now in the use of terms, technical education being used to describe all that which aims at a directly practical end as opposed to the education given at the college; while that part of it which does not deal with ornament or textile design is sometimes described by the same term. The word technology, which formerly signified the terms used in the sciences, now means the application of the sciences to industrial ends. The term polytechnic, originally used to describe schools of technology, has refused to yield to the more desirable synonym, technological, partly because it is an easier word, and partly because it contains a suggestion of the many-sidedness of the subject which the better word lacks. There is no good word corresponding to polytechnic or technological to apply to the persons who practice the profession indicated, and so these persons are called, now as always, engineers, and the business engineering. A few still cling to the term scientific schools in speaking of these institutions. In the present prevailing confusion of terms the best that can be said is that a polytechnic school teaches technology to engineers. Below the grade of the polytechnic there are multitudes of schools and parts of schools that teach the elements of the mechanic arts—many of them of the greatest interest and importance—and around it are many institutions that devote themselves to industrial art; but I must deny myself the pleasure of discussing any of these, with the important collateral questions of policy that they present, and proceed at once to the school we have in hand—the polytechnic. We shall find that all schools of technology, under whatever names, or with whatever special aims, present a common system of instruction complete in itself, with strenuous requisitions, a logical curriculum and a sharply defined end. In treating of technology, I am happily absolved from the duty of pointing out its importance; that is settled by the establishment of this school and others like it by the men who endowed them. They were men whose sagacity was too strong to be mistaken.

WHAT THE DISCOVERY OF THE LAW OF THE CONSERVATION OF ENERGY HAS WROUGHT.

Technology is essentially a new idea; it is certainly no older in its present aspects than the discovery of the law of the conservation of energy—the great idea of the present century. No discovery since that of gravitation has been so stimulating or so powerful. Its influence is incalculable. It is seen in the multiplication of labor-saving machinery for every form of work, the great array of useful inventions, the expansion of the system of land and ocean highways, and especially in the immense increase of the means for acquiring knowledge. This demand for economy of force and material has brought about great changes in the industrial arts; the apprentice system has disappeared; the necessaries of life being made by machinery, manual trades are no longer needed for that end, and skilled handicraft is a rare accomplishment. There is and there will always be a demand for skilled labor in the arts of building-construction, in pattern-making and similar forms of wood-work, in die-sinking and kindred arts that deal with the metals, and especially in assembling and finishing the parts of structures as they are delivered from machines; but this

is a small demand compared with what existed when shoes, clothes, furniture and tools were made by hand. The mechanic of the future will be a machinist. To such an extent is this replacement of handicraft by machinery true that we have shoemakers who cannot make a shoe, chairmakers who cannot make a chair, and generally artisans ignorant of the whole of any art. Mr. Batchelder, of North Brookfield, Mass., the largest shoe manfacturer in Worcester county, said that out of his six hundred men not more than ten could make a shoe. I once examined a very interesting picture of some pieces of iron that had been done by boys in an experimental forge-shop; the work seemed to be well done and creditable to the workmen; but out of some seventy pieces not more than ten would ever be made by hand at all in actual manufacturing.

Another result of the economy of force is that attention is concentrated now more upon the principles of phenomena than upon the phenomena themselves. Formerly the only hope of finding a better or cheaper way of doing things lay in the chance discoveries of ingenious men—men looked at things from the outside in; now it is seen that nothing is so fruitful and that nothing so advances human interests as a principle—men look at things from the inside out. For, nearly all mechanical ways of doing things were once regarded as out of the ordinary course of human affairs and to be relegated, if not to the domain of the supernatural, at least to that of the superhuman. The feeling towards scientific investigation as a means to practical ends partook of the same quality that infested men's views of disease; if typhoid fever prevailed in a given district the people did not look to their drains and wells, but flocked to church and appointed a day of fasting. What were regarded as the pardonable vagaries of Daniel Treadwell, Rumford Professor in Harvard University, turn out now to be the inventions upon which single-track railroads, the machinery for spinning cordage-yarn, the Armstrong, Blakely and Krupp cannon depend. I will venture, however, the assertion that no person in this audience ever heard before of these great inventions as Treadwell's; they came too soon for the world to know them as works of genius, yet they are the first fruits of the new era in which great problems are solved, not by happy inventions of geniuses real or affected, but by the sober and steady application by laborious scholars of established principles of physics.

NEW INVENTIONS ARE NOW ONLY SCIENTIFIC DEDUCTIONS.

Time would fail me to enumerate the influential inventions that have sprung from a similar origin. Who has not heard of the Siemen's Furnace, the Bessemer Converter, dynamite, compressed air and the uses of electricity? And it must also be remarked that each of these inventions demands corresponding machinery of novel design; for another feature of the new era is the necessity of reconstructing old machinery in more economical forms and the constant call for new machinery to meet new demands. When a new invention is made nowadays, machinery for it is as important as the invention itself. Perhaps the most striking illustration of the change in common things which has been brought about by technology is the rail on which railway traffic is conducted; formerly it was an iron edge rail, supported by chairs and having more iron in its base than the head; clumsy as this rail was, it was claimed to be the only form in which the only available metal could be used for the purpose; now the rail is made of steel, with well defined tread, web and base, the principal weight of metal in the head, where it is most needed, and every line subjected to the finest physical tests. To those who know how much of the best knowledge we have of physics and chemistry has been put, and is still put into a railroad rail, it seems one of the most interesting of all modern manufactures. It is not wide of the mark to characterize the past age as one of invention, the present as one of engineering. The study and mastery of the principles of physical science, the ability to express those principles in drawing and descriptions and to apply them to the solution of practical problems through machinery and handicraft are the essential qualities of an engineer. So that a polytechnic school, by whatever name called, technological, technical or engineering, teaches technology to engineers, i. e., it teaches the principles of physical science and their application to the industrial arts.

ENGINEERING A COMPREHENSIVE TERM.

Engineering is the term that includes all the arts of production and construction which arise from the physical sciences. Its object is to bend the forces of nature to the service of man.

The names applied to the different branches of engineering are not always appropriate, but in general, a civil engineer constructs public works, such as highways, railroads, water works, sewers, etc.; a mechanical engineer deals with machinery, from the original design of each part, through the machine shop and into the struc-

ture and to the operation of the structure, i. e., the machine; the chemical engineer applies chemistry to the manifold products that result from the play of chemism. Then there are numerous fields which the term covers: as hydraulic, steam, gas, electrical engineering. In each and all, the engineer is distinct from the artisan or craftsman by exactly the amount of his knowledge of the scientific principles which underlie the practice of his profession and his resulting ability to apply those principles to the ready and complete solution of real problems as they arise.

SCIENCE APPLIED TO PROBLEMS OF CONSTRUCTION.

For example: Mr. Batterson had occasion to cut a block of marble so as to produce a warped surface, for which his workmen had no patterns; the men had great skill in stone cutting, but could not cut that stone. A graduate of a school of technology happened to be employed in the city schools as teacher of drawing; hearing of the case at the marble yard, he tendered his services, applied the familiar principles of stereotomy, made patterns, and the men at once executed the work. Last November the Italian government made comparative tests of the power of different armor-plates to resist the shot of heavy ordnance; the plates that stood the test were made by Schneider, at the shops of the French technological school at Le Creusot.

The bridge over the Vistula river, at Warschau, was built by a graduate of Carlsruhe; that over the Volga, by English engineers; but the latest, largest and most costly bridge in Russia—over the Neva—was built by graduates of the Imperial Technological school of St. Petersburg, and every piece of iron that entered into it was tested in the laboratories of that school.

A few years ago it became suddenly desirable and important to pump out the central shaft of the Hoosac Tunnel; a suction pump was plainly inadmissible; the craftsmen had nothing to suggest; a young engineer built a small raft on the surface of the water in the shaft, lowered on to it a steam pump, set his boiler at the shaft mouth, had himself lowered to the raft, and alone in the darkness worked his pump twenty-six hours without accident and with great efficiency; men then tendered their services in abundance, and the problem was soon solved.

But the air is full of modern instances of the triumphs of engineering skill in overcoming great natural obstacles; the use of the inclined plane in the zig-zag roads over which horses trot in safety and at ease from Alpine heights to the valleys below; the application of compressed air to the two purposes of sinking caissons and driving machines at a great distance from the source of power, the use of the friction clutch, the air-brake, and a thousand other examples of the application of the familiar principles of science to the solution of mechanical problems. In each case, however, it will be noticed that one man may understand physics thoroughly, as thousands of men have understood the subject, and another man may understand the construction of machinery, but not one of the triumphs of engineering above mentioned be achieved. The theoretical knowledge of physics and the practical command of machinery must come together; if this happy conjunction occur in one and the same man, the best results follow. Then the same affluent good comes forth in the domain of mechanics that abounded in the middle ages, where the artist and artisan were one; when Peter Vischer and Quentin Matsys worked at blacksmithing, and Michael Angelo cut stone, and Benvenuto Cellini hammered silver and gold, each touching the iron, or the stone, or the silver, with a beauty and value that all the ages since have only enhanced.

Here some one will surely interpose the fact that E. B. Bigelow, the inventor of the modern carpet loom and one of the greatest of American inventors, could neither make one of his own machines nor the working drawings for it. His head was an amazing tangle of mechanical contrivances, but the draftsman and mechanic were indispensable to the successful evolution of them. This of course was a temperamental matter with him. We cannot change the fact that many inventors cannot express their own ideas; nor am I going to claim that any amount of technical training or of any other kind of training is likely to aid a so-called mechanical genius very much. Indeed, Mr. Bigelow never admitted to me at least, that a course in technology would have aided him; the nearest approach to such a concession was the remark, at the close of a busy forenoon spent in studying the Worcester school: "Well, I'll go home and consider how all this would have affected me had I begun here as a boy." I do not think he would have begun there or in any other school, for he was a genius in the best sense. A genius is a law to himself, the processes by which the mass of men must gain knowledge are strange and useless to him; generally he is a poor adviser in educational questions. He can never be educated in any sense in which the word is understood by ordinary men. Still, by a knowledge of the principles of mechanism and the methods of expressing and applying

those principles, the ordinary inventor would secure to his use the benefit of his own inventions which somebody else so often appropriates, and would save the Patent Office much of its costly and superfluous rubbish.

THE GRADUATE IS BUT A BEGINNER.

No graduate of any school is at that time an engineer. The qualities of good judgment and efficient reason grow only in the atmosphere of experience. Hence no diploma can be regarded as meaning anything more than that the possessor has passed successfully the examinations that are set at any particular school. Graduates should begin at the bottom of their profession and their school training will tell best and most effectively in the rate of their advancement. They will advance more rapidly than others along the lines which are determined by their natural aptitudes.

The Almighty makes superintendents and leaders of men—no school can do this. But the training required for a superintendent must be that of his subordinates. All the best experience of the world sanctions this rule. A superintendent who has not had the training of the shop is as useless as Achilles without his weapons—he may seem and assume to direct and to lead, but he does not; on the other hand, the man who attempts to lead without natural leadership, however wise, is as useless as the weapons without Achilles.

The question how men shall best be trained for engineering was asked long ago before any practical result ensued.

The Marquis of Worcester, imprisoned in the Tower of London, 1645, working industriously upon his steam and water engines, cast eyes upon a lot which he could see from his window and instructed his agent to buy it, intending, he said, as soon as he was set at liberty to erect a school wherein boys might learn something of the principles of the mechanic arts. But he never was allowed the opportunity to carry out his idea.

There is an interesting letter from President Leonard Hoar, of Cambridge, to Robert Boyle, in which the good man, after acknowledging some favors from Boyle, discloses to him some darling projects of his own about the improvement of the course at the University and says: "I would have a large, well sheltered garden and orchard for students addicted to planting; an ergasterium for mechanic fancies, and a laboratory chemical for those philosophers that by their senses would cultivate their understanding; for the students to spend their times of recreation at them; for reading or notions are but husky provender." Boyle did not encourage the President, and his project slumbered for two centuries, but was at last substantially realized in the Lawrence Scientific School.

THE PIONEER POLYTECHNIC SCHOOL OF THE WORLD.

The first independent polytechnic school was the Ecole Polytechnique in Paris, founded in 1794. The Ecole Centrale followed, and during the first quarter of this century similar schools were established all over France, Switzerland and Germany.

AMERICAN POLYTECHNIC SCHOOLS.

In this country, the best appointed and on the whole, the most worthy of study as far as methods go is the Military Academy at West Point; then we have the Columbia School of Mines at New York, the Sheffield at New Haven, the Rensselaer at Troy, the Institute of Technology at Boston, the Stevens Institute at Hoboken and many others. These are examples of pure and independent schools of Technology, each with a special end of its own, but possessing all the generic features of the class. They all arose from the demand for engineers in the arts of peace and of war. To this list must be added the state colleges of agriculture and the mechanic arts, several of which have made provision for effective teaching in engineering. The polytechnic school has always offered to the qualified average boy a good education based on drawing, the mathematics, the living languages and the physical sciences, tending to qualify him for immediate entrance upon the duties of an engineer.

COURSES OF STUDY IN POLYTECHNIC SCHOOLS.

The course of study in a polytechnic school is determined by long experience and in all countries is substantially the same. It includes:

Mathematics—Beginning with algebra and geometry, and proceeding through trigonometry, analytical and descriptive geometry, the calculus, theoretical and applied mechanics.

Physics—From the elements to the solution of problems, sometimes with laboratory practice.

Chemistry—With laboratory practice.

Language—The elements of German and French, (English replacing one of these in European schools) and the mother-tongue.

Drawing—Beginning with free hand and including perspective, orthographic and isometric projection, shades and shadows.

Geology and mineralogy as far as time permits. The other natural history sciences are necessarily omitted, except in special cases. In all these schools the instruction is given with a strong practical bearing, and generally the students learn the manipulation of the instruments used in surveying, and the more important of those used in physical researches.

SCHOOLS OF TECHNOLOGY NOT SCHOOLS OF DESIGN.

It is necessary to remark at this point that technological schools do not include schools of design. There is a great interest in European countries and in the United States at the present time in what is called industrial art, meaning the study of form, color and ornament to render structures and manufactured goods intrinsically more beautiful, and to increase their value by this means. A department of drawing and design has a place in a school of technology, but engineering does not naturally include the work of a school of design.

But polytechnic schools as they were did not meet all the wants of the new era. Practical men detected a lack in engineers who had been trained without actual contact with a machine shop—there was a surplus of theoretical engineers and a dearth of practically efficient ones.

The principle of the division of labor resulted in making it next to impossible for a boy to find a place in any machine shop to learn the trade. The owner did not want him because it could not be in any way conducive to his business interests to employ a person ignorant of his business; and if he employed him at all he kept him on a single sort of piece-work, from motives of self-interest. Trades Unions conspired to keep out apprentices from shops, and so it came to pass that a boy could not get a good working knowledge of machine-shop practice except by stealth.

HOW THE WORCESTER FREE INSTITUTE AROSE.

This demand for mechanical engineers with work-shop training, and the practical impossibility of finding a place for a boy in any good machine shop, led to the establishment of a polytechnic school in which a manufacturing machine shop is a prominent and thoroughly administered feature. This is the school known as the Worcester Free Institute.

This institution was organized under the influence of a belief that, after all that has been done in technology, there is still need of a system of training boys, broader and brighter than "learning a trade," and more simple and direct than the so-called "liberal education;" that while the boys should be thoroughly trained in all the essentials of a polytechnic course, they should also find a work-shop open where they could get all the essentials of a trade; so that upon graduating they should have sufficient knowledge of machinery and handicraft to enable them to earn a living while pushing their way up to the highest positions for which nature and their training had qualified them. It was held that not the least important of their qualifications for high positions is a good experience of the lower positions.

"It is the undoubting opinion of the managers of the Institute, and of all who have watched its operation, that the connection of academic culture and the practical application of science is advantageous to both, in a school where these objects are started together and carried on with harmony and equal prominence. The academy inspires its intelligence into the work of the shop, and the shop with eyes open to the improvements of productive industries prevents the monastic dreams and shortness of vision that sometimes paralyze the profound learning of the college." *

UNDERLYING PRINCIPLES OF THE WORCESTER SCHOOL.

This school was opened in 1868, with the following fundamental ideas:

1. That all mechanical engineers will find their account, in future, in going through a work-shop training.

2. This work-shop instruction may precede, accompany or follow the intellectual training, but for many reasons it preferably accompanies it.

3. The work-shop instruction is best given in a genuine manufacturing machine shop where work is done that is to be sold in open market and in unprotected competition with the products of other shops.

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* Worcester Catalogue. P. 7.

4. That in a course of three and a half years, working 800 hours the first half year and 500 hours a year thereafter, a boy beginning without any knowledge of mechanics can acquire skill enough to offer himself at graduation as a journeyman and will be found on trial not inferior to those who have spent the entire time of three and a half years in a regular machine shop.

5. That the work-shop practice must be a part of every week's work in the institution; that it shall be momentarily supervised by skilful men, and that the student must not expect or receive any pecuniary advantage from it.

6. That the question who shall be a superintendent or foreman or engineer engaged in designing or drafting machinery cannot be settled in any school—that being a question to be determined only by actual trial; because the discipline of the judgment by actual practice into which personal responsibility enters is vitally essential to a valid claim to the post of superintendent. Hence, it will follow that, while all receive the preliminary training requisite for engineering, many will not attain to it, but these will find a full reward for all their time and labor in superior intelligence as workmen—in being masters and not servants of the machines which they make or run.

7. A seventh principle was announced when the first class graduated, and has been inculcated into all their successors, viz: that the value of the education they have received will show itself in the rate of their advancement and will be easily detected by their employers, and that they should not be so much concerned, in seeking places, about great wages or high positions as about the chances ahead for advancement; indeed there might be cases in which they could well afford to work a while for a bare subsistence, such would be the value of their experience.

These principles have now been tested under as favorable conditions as could be desired for fourteen years, and this experience all goes to confirm them. No valid objection has been urged and no adverse criticism worth a moment's attention has been heard. The expense attending the proper development of this plan is the only difficulty in the way of its general adoption; but, within the brief period of its existence, the Worcester School has seen two great institutions founded on its plan, the Miller School in Virginia and the Rose School at Terre Haute.

Now since the principles just recited are to be the regulating force in the organization of this school, some discussion of their grounds is in place.

PRACTICAL KNOWLEDGE OF SHOP WORK ESSENTIAL.

No argument is needed to prove that an engineer should have practical acquaintance with handicraft and with the machine shop in general. The great demand for men who have this qualification and the surplus of unemployed theoretical engineers, otherwise able and competent men who lack it shows that the point is well taken. The experience of the older countries sustains this view. It is found in Austria, so the Baron Von Eybesfeld (Minister of Public Instruction) told me, that there is a great excess of graduates of the polytechnic over the demand, and that he is now engaged in organizing a new kind of school in which workshop instruction shall form part of the course, so that the country may have some men for foremen and superintendents of works who are thoroughly versed in the practical details of machine-shop work. In carrying out this new policy, the latest phase, it will be noticed of technology, the great Gewerbe Museum has been organized and put in charge of Dr. Exner, a strikingly competent and efficient man. He has started two totally distinct sorts of schools: the first is substantially a half-time school, in which boys from the higher common schools work half the day and study the other half, receiving instruction according to the polytechnic plan as far as the time permits; the course being two years, these boys do not receive as much instruction as the polytechnikers, but they have the immense advantage of practical power in the shop, which secures them a living and adds to their value. Every stroke of work in the shops is done with reference to the sale of the articles, and no fact was mentioned oftener, or with more evident satisfaction by Dr. Exner in proof of the solid excellence of the school than that they sold in the first year a thousand gulden worth of their work. It is intended to multiply these schools so that they shall provide a great variety of mechanical practice (the two now in operation being devoted wholly to wood working) and to extend the course to four years. When this has been done there will be in Vienna two schools in which all the principles of the Worcester Institute will be adopted and applied.

THE AUSTRIAN EXPERIMENT IN COTTAGE INDUSTRIES.

The second line along which the Austrians are moving is in cultivating what are known as cottage industries; this movement is so interesting that I shall venture to say something about it, though it is not immediately germane to our purpose.

There is a marked tendency in Austria to concentrate population in large cities. The population of Vienna has grown from 800,000 to 1,200,000 within ten or twelve years and other cities show a great increase; this has occurred without a corresponding increase in the total population; the inference is that the growth of the cities is depopulating the villages—an unmistakable and alarming fact. Inquiry into the causes of this movement has brought out the fact that the peasants of these villages have lost the market for their baskets and other wares because their Swiss and French neighbors, who have had abundant schools of industry, have devised new and more attractive forms for the same wares. The peasants of Austria were unable to compete because, through their ignorance of design, they were confined to the old and unsalable forms, and with the fatuous haste so often seen, crowd the cities in the vain hope of bettering their lot. Dr. Exner, under the general direction of the wise and acute Minister of Public Instruction, has started schools for basket-weaving—by far the most important of these household industries. Half of the day is devoted to learning new and better ways of basket-weaving, and half to drawing and modeling in clay; the result being that the pupils learn how to do the things that are now in demand and are clothed with power to design whatever forms the future may suggest. Anybody may attend these schools who chooses to come to Vienna; for there only can a museum of examples be gathered sufficiently ample to enable the minister to multiply the schools so as to provide for other industries as well as basket-weaving. The hope is that the more intelligent young peasants will attend these schools and carry back to their villages the new ideas; this being done, a check will be put upon the tendency of people to leave the villages, because they can again be prosperous and happy where they are.

SUMMARY OF REASONS FOR COMBINING SHOP WORK WITH SCHOOL WORK.

Upon the question whether workshop instruction should precede, accompany or follow the school training opinions differ, and a full discussion of the subject is impossible within the limits of this address. This subject occupied the attention of the American Institute of mining engineers through two prolonged and intensely active sessions in 1876, and the results are embodied in a valuable pamphlet which presents the views of the ablest engineers in the country. I will briefly summarize the facts and motives which seem to leave us practically no alternative but to incorporate the shop practice with the school-work. Boys fitting for a polytechnic school cannot leave the preparatory school younger than sixteen; if they are to get their shop-training before the polytechnic, they must spend three years at it and at the end of the time they will be rather too old to get the best advantage of the school, and miss the all important opportunity of applying their theoretical knowledge as they go along.

If, on the other hand, boys defer the shop till after graduating, they will find many excuses for slighting it or for not doing it at all. At the age of twenty, with a good knowledge of drafting and well disciplined faculties, American boys would be far more likely to turn into draughtsmen or to take their chances in business than to submit to the dull routine of elementary shop-practice. Theoretically there is much to be said in favor of this plan, for it brings to the work-shop the trained powers of the school and makes the practice continuous. It is the plan of the Russians, in the Imperial Institute of Technology at St. Petersburg, certainly one of the best technological schools in the world, where the students, after a four years course in pure technology with the usual holidays and vacations, return on the first day of September and work in the machine shops till the first day of the following September, ten hours a day without vacations, and the results are very satisfactory. But the Russians can carry out such a system because the government controls the positions to which the students aspire and without which they must starve, and makes the fifth year of practice compulsory. Very few who have had much experience in teaching American boys believe that such a plan could be successfully adopted here.

There are many solid, positive reasons in favor of incorporating the shop-practice with the intellectual discipline. The period of a boy's life between sixteen and twenty-one is the period of sharp acquisition; ideas taken then remain in a special sense a part of the mental furniture forever. Probably no one, whose course of education is uninterrupted, acquires as much as between the ages mentioned, or retains what he acquires as long. It is an interesting fact that the enthusiasm which an American boy cherishes for his college, an English boy feels for his school, where the training he most values was received. The American hurrahs for Yale or Harvard—the English for Eton or Rugby. The same would be true here were all our boys fitted for college at a few large schools and fitted as well. This being true, shop practice has an advantage it would otherwise lose in coming into this period.

ADVANTAGES OF A SCHOOL WORK SHOP.

Again, a man whose matured and furnished mind has laid hold of the strong problems of theoretical mathematics in school, and who finds himself on the threshold of manhood does not bend himself with just the same ease as an undergraduate to the elements of machine-shop practice. There is some advantage, too, in beginning shop-life in periods of five hours semi-weekly over ten hours a day; for less time proportionally is wasted. And finally, a great economy of the precious time of the students is secured because shop-work serves the double purpose of practice and of exercise.

Why the school workshop should not be a shop in a complete sense and not a mechanical laboratory or some other device for escaping the hard but necessary discipline of a shop, has not yet been stated. There is a difficulty in meeting the first cost and inevitable annual deficit, but if any other valid objection has been made to the plan it has escaped my attention. It offers every advantage of every other form of school-shop, with immense additions.

The advantages of a shop in which actual construction is made to aid in instruction are numerous; a few only can be mentioned. These boys are all hoping to be engineers, at least they may expect to become skilled workmen or draughtsmen. In any event the more the faculty of judgment is cultivated, and the more the boys realize the nature and extent of the difficulties that actual practice presents, of which the best theoretical knowledge gives no hint, the nearer they are to attaining the end they seek. We have seen that no graduate of a school is an engineer, but is in the best way to become one. Why not advance him as far as possible? If now the student's comprehension of the principles of engineering is clear and his weekly practice enables him to see those principles in action under conditions as like as possible to those which he will meet in real life, his entrance upon the life of an engineer will be an expansion of his school-life, and not an abrupt transition from it to a new mode of life. The more his work is subjected to the inexorable tests of business, and the more he feels in the use of his materials just the same responsibility that rests upon an actual workman, the better he is. He must make the things that are to be used and not those contrived to suit the peculiarities of his temperament, the exigencies of his situation or the mere purpose of instruction. There is nothing that a student needs to make in a school workshop from which he cannot gain something if he puts the article into its final serviceable form.

Applying the stern test of serviceableness is the only way to know whether the things that have been made were worth the making or not, and is the only way to correct any tendency to visionary structure that is so apt to infect a school workshop, and to prevent that sublimation of common sense which is apt to ensue when responsibility for the correct use of costly materials is removed.

There is no merit or charm in work, considered merely as work; to work to produce something that some one else wants and cannot make for himself and is able to pay for is the stimulus of industry. All work in school-shops or any other will ultimately obey this law or else it will evaporate into exercise or sport.

Workshops into which the principle of construction does not enter are liable to exalt the importance of the purely literary aspect of mechanical knowledge. It is possible to know the five hundred and seven mechanical movements, to know the best cutting angles of saws, files and edge tools and not be a mechanic or be in the way of becoming one. This kind of knowledge is useful and attractive and desirable when it is not offered as a substitute for the dexterity that can be obtained only by the use of the tools. It will not do to regard our ancestors, the skilled mechanics, as fools. There is still but one way to learn to file and that is to file. The most expert filer I ever saw could not write his name. I do not think he could have filed any better had this simple accomplishment been added to his merits; he would have been a better and a happier and more useful man with more knowledge, but he did that one thing as well as it could be done at that time.

MACHINERY RAPIDLY SUPERSEDING HANDICRAFT.

But this thought instantly suggests another of the greatest importance, viz: handicraft occupies a constantly narrowing place in the mechanic arts; machinery a constantly widening one. Every year adds to the number of trades from which the machinist has driven the craftsman. It is clear then that no training of boys for the life of mechanics is complete which does not make them familiar with machinery and machine-construction.

There is one demand sometimes made upon the school-shop which is unjust, namely, that it should pay its way. How can it pay its way when so large a part of its force is spent in teaching boys? If so many machine shops in this country, fitted up and managed with especial reference to money-making fail in business, or

only make the ends meet by the most painful efforts, how can a shop one-half of whose effective force is spent in teaching boys, who cannot for the first half of their time produce anything salable, hope to pay its way? Teaching in school-shops costs as teaching elsewhere costs.

THE SCHOOL AT MOSCOW, RUSSIA.

Many difficulties have been met and overcome, and many more which wore a threatening aspect ceased to be difficulties at all when the time came to deal with them. It is idle to spend time, therefore, in enumerating and discussing these difficulties. Those that remain are of trifling magnitude. It is better and more interesting to turn attention for a moment to another solution of this problem of technological education in the school at Moscow, in Russia, which was opened almost exactly at the same time as the Worcester school, and is now administered on the same general plan. I visited the school last October and will record a few observations upon it. The first room, into which I was shown by the superintendent of the shops, half the size of this chapel, was devoted to conferences with purchasers of machinery and would-be purchasers, who needed the aid of an engineer to design and draught machinery for special purposes; all the machinery thus designed is made in the school-shops. This room was filled with large drawing tables, on which lay working-drawings of machinery in various stages. The second room I saw was the engine room, where a twenty-horse engine was doing its best to drive the machinery of the shops, and later I saw a duplicate of this engine, every part of which had been cast and finished in the school-shops. The third rooms were the machine-shops, smithy and foundry, where a hundred workmen are employed in the double duty of manufacturing, and instructing the students how to manufacture; mingled with the workmen on that day were about sixty students. The fourth room was a store house in which was exhibited 60,000 roubles worth ($30,000) of machinery and machine tools, being the result of one year's work, and just brought back from the annual exhibition of the Industries of Central Russia. An equal amount made during the previous year has been sold. The fifth rooms were a series of smaller apartments in which, for convenience, the students begin their practice. The method of teaching them is this: each year about eighty boys are received at an average age of seventeen and a half years; the course of study is six years, of thirty-two weeks in each year; for the first, second and third years, the boys all work in the shops fourteen hours a week, or 448 hours annually; for the fourth, fifth and sixth years, ten and a half hours a week, or 336 hours annually, so that they work an aggregate of 1344 hours in the first three years and 1008 the second three; the rest of their time is occupied with the ordinary curriculum of a polytechnic school. The practice for the first three years, or rather more than half of the whole is spent in preparing for that of the second three; i. e. for the first half they do not attempt any manufacturing, and for the second half do not do anything else.* In these rooms the boys were filing, forging, sawing, turning, etc., each as fast and well as he could, all the boys in any one room being responsible to the foreman of that room, whose duty it is to provide work for each boy and decide upon its quality. Each boy is pushed as far as possible in the time allotted to each room regardless of his mates. The work done in these rooms is mainly thrown away, though some is saved for models.

THE MOSCOW SCHOOL SHOPS A MANUFACTURING ESTABLISHMENT.

But the boys are just as much in need of direction and efficient skill when they emerge from the elementary shops as they were before, and it never occurs to the faculty that one of these boys is fit for any shop but their own until his course is completed, any more than an ordinary college faculty regard sophomores as ready to study theology. The boys in the elementary shops have free access to the manufacturing shops, see where every piece they are making fits and how it is used—they do everything in a manufacturing atmosphere, and every boy who passes the requisite examinations, with very few exceptions, passes into the manufacturing shops. The Moscow school-shop is a great manufacturing establishment and, if the manufacturing element were removed, the school would be either revolutionized or extinguished. The elementary shops are a convenient, and for that school, serviceable and economical device for doing what all school work-shops must do, separating unsalable work from salable, and keeping apprentices at work by themselves though in full view of and in full co-operation with the manufacturing shops till

* The Superintendent said that if one of the boys in the preparatory room made anything salable they did not hesitate to sell it.

they have skill enough to begin to do salable work. My conviction is, however, that the results are not what might be expected; for the work done by these boys at the end of their first half year course, or after 1344 hours practice, does not compare favorably in excellence with that done by the boys at Worcester after their first half year, or 800 hours, and candor compels me also to say that the work of the graduates at Moscow is at least not at all superior to that of the Worcester men.* The graduates of this school and of that at St. Petersburg compete for the same prizes and all obtain good positions in manufacturing establishments.

Some statistics will show the thoroughness of the discipline of the school and the importance attached to it by the government. The government appropriates 250,000 roubles, or $125,000, annually to this school (and the same to St. Petersburg). The number of Professors is fifteen, of Lectors ten, all others three. The tuition is 150 roubles, or $75.00, a year. The floor space at Moscow is not less than 400,000 square feet—that of Worcester is 50,000.

A set of plans of the building will soon be found in our library.

It adds great force to Russian examples and precedents to know why we find their polytechnic schools of such rare and unsurpassed excellence.

ADMIRABLE EQUIPMENT OF THE POLYTECHNIC SCHOOLS OF RUSSIA.

The popular impression of Russia does her great injustice. The educated Russians are a highly educated and accomplished people. Part of this intelligence is due to the intermixture of the German population, which began soon after the death of Catharine and has continued to the present time. Now, when the Russians began, about fifty years ago, to attend to the development of their internal resources in a scientific manner, they started in the most sensible way, by sending commissioners to study the systems of technological education of Western Europe. These men winnowed Europe for ideas. These ideas they carried to Russia and expanded into schools which surpass in completeness of equipment and affluence of resources all others in Europe, with the possible exception of the Ecole Polytechnique, in Paris. They had the money to give German ideas of education and expansion and development of which the Germans, in their poverty, never dreamed. Russia is the lee shore upon which the choicest educational pebbles may be gathered. In studying Russia one sees all European technological education epitomized.

And since the notice of these inauguration exercises was printed I have news that the Imperial Institute of St. Petersburg has stretched her hand across the wide waters to give us a welcome into the fraternity. Notice has come that a box of examples of the work done there and a collection of drawings has been shipped as a present from one of the oldest to this, the youngest of the polytechnic schools.

SUCCESS OF THE SYSTEM AT WORCESTER.

But I must hasten to complete this exposition of principles. The fourth fundamental at Worcester is that in a course of three and one-half years a boy, by working 800 hours the first half year and 500 hours a year thereafter, can gain as much dexterity and be as fit to offer his services as a journeyman as he would be had he worked three and one-half years steadily in a modern machine-shop. The experience of two hundred graduates of the Worcester school, and the opinions of the manufacturers in whose shops they have found employment, establish the fact. Some of the reasons for this somewhat paradoxical result are that in an ordinary machine shop a boy must spend his time in his employer's interest and not in his own, and only a small portion of that time is devoted to teaching him manipulation; in the school-shop the time is wholly used in teaching. Again, the student-apprentice is under daily training in school and comes to his work with alert faculties and acquisitive powers constantly growing stronger. This is especially true with reference to his weekly practice in free drawing, a study which tends to develop and train the sense of form and proportion, the very training that a mechanic most needs. And, again, the work of the student is done under the eye and with the ready assistance of a skilled workman whose duty it is to teach him, by precept and example, all he can learn. Meantime, while he has been getting his manual dexterity, our student-mechanic has obtained a good education. The remaining principles require no further explanation.

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* The work done by the graduate-mechanics of St. Petersburg is especially interesting because it is evidence of the advantage of well-disciplined faculties in acquiring skill in handicraft.

LIFE WORK OF WORCESTER GRADUATES.

It will now be asked what may the graduates of this school be expected to do To this I reply by reciting what the graduates of the Worcester school have done

Occupations of graduates—

Partners in business firms	2[illegible]
*Superintendents	1[illegible]
Chief Engineers	[illegible]
Division Engineers	[illegible]
Assistant Engineers	1[illegible]
Civil Engineers	2[illegible]
Draughtsmen	4[illegible]
*Mechanical Engineers	1[illegible]
*Machinists	1[illegible]
Foremen	8
Teachers	17
Chemists	12
Advanced Students	4
Designers	5
Others, mostly engaged in manufactures	45
	246
Deceased	9
Total	255

More than ninety-five per cent. of the graduates are engaged in occupations for which their training at the Institute specially prepared them.

MODIFICATION OF WORCESTER PLANS PROPOSED AT ROSE POLYTECHNIC.

In the Rose school the following modifications of the Worcester plan will be attempted:

1. The course of study will be four years instead of three and a half.
2. The practice will be concentrated in the first year and diminished in the fourth, so as to allow time for more instruction in machine-design.
3. While the same subjects will be taught, perhaps more attention will be given to the humanities.
4. A different view will be taken here of the profession of civil engineering from the one usually held. The young men who propose to be civil engineers will spend a part of their practice time in the machine-shop.

Civil engineering cannot easily be separated from mechanical, because the most important business of a civil engineer nowadays is not surveying and mapping but bridge and building construction, the setting of water-wheels and other engines, and such like undertakings which involve a knowledge of mechanics; so that two or three of the best so-called civil engineers in the country have given it as their judgment that a course in mechanics including workshop instruction, is the best way to prepare for the practice of civil engineering.

But on the other hand, the building of new highways and railroads still goes on and calls for a certain number of young men who are expert in the use of the transit and level (especially in railroad problems) who know how to draw and who understand mensuration; hence, training for this sort of employment cannot be neglected in a polytechnic school. It would conduce to clearness to call such work Topographical engineering.

An added consideration of some weight in favor of retaining a distinct department of Topographical engineering is that many of the young men who frequent technological schools have no taste or aptitude for mechanical work, and some have not the requisite physical vigor for it, whose fitness for success in field-work or in mapping is unquestionable. But it will be clearly advantageous to all to have some workshop practice. No changes will be made except such as reason and a large experience show to be desirable and advantageous to the student.

But a healthy child wants food. An adequate beginning must be sustained by continual contributions in order to good progress. We want the sympathy and patient consideration of the community. We want books, apparatus and models constantly in excess of the resources of our funds. The example of our founder is worthy of attention and imitation.

*Many of these are "Master Mechanics."

The machine-shop is ready; a reference library will soon be on the shelves; a cabinet of minerals is on hand; ample models are ready for the proper equipment of rooms for drawing and design; the bricks for a new building for a chemical laboratory are now lying in the yard; apparatus for chemistry, physics and field work is in the building or provided for; commodious recitation and lecture rooms are ready when wanted.

I hope also, in course of time, to collect models and examples of the best mechanical devices, and also of leading manufactures. These collections of models play a very important part in European technological schools, and for obvious reasons. Indeed, the outlay in some cases is enormous and would be insupportable did not manufacturers find their account in placing here examples of their best work. At Chemnitz I saw two good examples of this class: one a perfect working model of the Hartman locomotive, which cost $3,000, and the other a large working model of the Merkel stationary engine, worth $250—each presented by the manufacturer.

In order to any effective use of these resources two things are vitally requisite: good teaching before the students enter the Institute and good teaching afterward. It is on the whole, a mistake to suppose that fitting for the polytechnic is essentially different from fitting for any other form of manly labor in this world which depends upon a sound, instructed brain. Technically, boys will be examined for the present in English grammar, geography, United States history, arithmetic, and algebra as far as quadratic equations; but these are the essentials of any success at all in the polytechnic; the more a boy knows before he comes the broader and deeper his success will be. The polytechnic is a professional school and must concentrate itself upon its own special work; but the broader the base on which it builds, the more massive the structure that can be reared. Whether the polytechnic course shall rear an obelisk or a pyramid depends on the preparation of its students.

Men are born as ignorant as they ever were and the same steps from ignorance to the elements of all knowledge must be taken by every one. This work usually occupies the first fifteen or sixteen years of every human life.

It is very desirable that every boy that presents himself for admission here should have at least a full high school course; if he cannot get that, let him make the closest possible approach to it. Youth once passed, the opportunity for acquiring the rudiments of knowledge is usually gone forever. An eye hath not seen nor ear heard a sadder thing than the lament of a man who, amid the emergencies of life, suddenly confronts his need of some simple knowledge which he might have got for the asking in his youth.

QUALITY OF THE INTELLECTUAL TRAINING AT WORCESTER AND AT ROSE POLYTECHNIC.

The greatest solicitude will be ever cherished here about the quality of the teaching. It is not intended that students shall find more assiduous or competent teaching in the various branches of the course than will be constantly found in this institute.

But there is one peril and annoyance to which the new polytechnic is subject: handicraft in school never having been used before except for reformatory purposes, the impression gets abroad that the institution must lower its intellectual standing to raise the handicraft. I do not know an institution in this country except West Point where boys achieve as much good work or are better prepared intellectually for effective service as engineers than they are at Worcester. We propose to give the same training here.

If what has now been said seems to have a too exclusive bearing upon the study and practice of mechanics it is because this is the leading department, and presents the only novel and difficult features of our enterprise; but there will be departments of civil engineering, physics, chemistry, and design organized on the same general plan; the studies will be the same in all departments—the practice different according to the purpose for which it is intended. These departments naturally group themselves; for chemistry, physics, and drawing must be taught to mechanics, and the additional expense required to give practice in each of these departments to those who prefer it to mechanical practice is very small. The outlay required for civil engineering practice is justified by the demand.

Later in our enterprise a department of Mining Engineering may be organized; and in the department of physics special attention will be given to electrical engineering. All this will come about in due time. It will be observed however that only one kind of practice can be profitably taken by any student, during the course. Full particulars in regard to all these matters will be seasonably given.

THE POLYTECHNIC SCHOOL HAS COME TO STAY.

If this account of the origin and method of the technological school be correct, it is obvious that it is no longer an experiment, that it fills a gap, that it is a natural, inevitable, every way desirable and welcome concomitant of modern civilization.

It does for the industrial arts what the colleges have so well done for the learned professions by fitting men in a carefully planned course of study for the intelligent discharge of their duties.

The polytechnic seeks to work as an ally of the old classical college, and hopes that her old friend may find something to her advantage in studying the economy of force which prevails in the methods and results of the newcomer. The polytechnic does not sustain any organic relation to the college such as the academy has on the one hand and the professional school on the other; yet in a deeper sense it sustains a very important relation to it. Whatever tends to increase or foster the desire for knowledge tends at once to foster all institutions whose object is to promote knowledge. Every new institution tends to increase the interest in the old—provided the old are worthy. Of course, I do not mean by "new institutions" repetitions of old types, such as the multiplication of small colleges, for this is generally an evil rather than a good (except in new States), but I mean new institutions, like polytechnic schools, that strike their roots into new soils and make what was once a desert blossom as the rose.

Technical schools have not affected the colleges unfavorably in the matter of attendance; for in spite of the crowds that have flocked to their doors, the classes in the colleges have steadily increased. More new colleges have been founded during the period of the rise of polytechnic schools in this country than in any similar period before; the old colleges have received munificent increase of their resources and have more than held their own in the matter of attendance, and all the students attending the state universities in the course of Liberal Arts may be reckoned as a solid addition to the ranks of the college.

For obvious reasons the polytechnic school flourishes best when separate and distinct from the college; but the more it flourishes the more it will directly benefit the college by providing for the instruction of the youth who demand the so-called "practical courses" and thus leave the college free to pursue her own legitimate work. Towards all forms of knowledge technology is hospitable, and towards all who know, engineers are affectionate. The study of science in a teachable and reverent spirit does not beget intolerance or bigotry. Science inculcates hatred of pretense, and is intolerant of dogmatism; but mindful of the counsel of her greatest disciple, she utters the solemn words of Bacon:

"This also we humbly beg that human beings may not prejudice such as are divine, neither that from the unlocking of the gates of sense, and the kindling of a greater light, anything of incredulity or intellectual night may arise in our mind toward Divine mysteries."

The day has forever passed when the old idea that the study of Latin, Greek and the humanities is the only education. The definition of an educated man will bear still more expansion, but it has broadened rapidly, during the last quarter century. *"The vulgar argument that a study of the classics is necessary to make a gentleman is beneath contempt. Honor and gentleness are not a dye or a lacquer, but warp and woof. It is true that a certain social consideration attaches to persons who are supposed to know Latin and Greek, whether they are gentlemen or not;" but society is rapidly adapting itself to the new era in which men and women are to be taken for what they are and not what they are said to be.

It is an unique and interesting fact that most of the polytechnic schools have been founded and endowed by private benefactors. The colleges, seminaries and academies have depended at times upon legislative fostering. Hardly a session of a State legislature passed prior to 1873 without considering some bill in aid of an educational institution. But the strong point about polytechnic schools is that the enormous expense of founding and administering them has been provided in most cases by individual citizens who knew their value. The Ecole Centrale in Paris, next to the Polytechnique the best in France, was the joint product of the brains of Dumas, Pictet and Ollivier and the pocket of their friend Lavallee, who paid all the expense of starting and running the school for five years, and at the end of that time presented it to the government. In this country Lawrence at Cambridge, Van Rensselaer at Troy, Sheffield at New Haven, Stevens at Hoboken, Boynton, Washburn and Salisbury at Worcester, Rose at Terre Haute, Case at Cleveland and many others have said in tones which many generations will hear what they think of the value and importance of technical education, and have made the State the recipient and not the nurse of their bounty.

In the city of Glasgow, nothing impresses a traveler more amid all its teeming industries than two monuments, one of great height and majesty to John Knox, the other a simple tablet in the wall of the cathedral to the memory of George Bailey who founded unsectarian schools and libraries for the operative classes.

*President Eliot.

The city of Terre Haute will cherish none of her treasures longer than the memory of her princely benefactor; but her choicest heritage is the inalienable right to put upon his monument with a change of name the inscription which can be read at the grave of Copernicus in Warschau:

To CHAUNCEY ROSE, OUR FELLOW CITIZEN.

President Thompson's inaugural being concluded, President Collett called upon Dr. Barnabas C. Hobbs, a former member of the Board of Managers, and now a trustee of the State Normal School, who thus responded:

DR. HOBBS'S REMARKS.

About eight years ago I became personally acquainted with Chauncey Rose by accepting an invitation to make his house my home, while attending a State Educational Association. During a breakfast conversation my bachelor host stated that his friends had been advising him to get a wife, and turning to me said, jocosely, "What do you think about it?" I answered that "Men sometimes had an unwritten history, and until I knew his I did not think it well to give him any advice." He thoughtfully remarked, "You are right, sir, I have an unwritten history."

I saw from his manner he had sympathies the world knew not of, and that he was not an enemy to woman. Sometime after this on the occasion of another visit, he told me how anxious he was to use the means at his disposal in a way that would do the most good. He had been a successful business man, and everything he had undertaken seemed to have been a success. He asked me what I thought he had best do. I told him that I thought no investment would pay better than one paying the expenses of deserving young women in the Normal School. Women had a hard time in finding profitable employments, and teaching was exactly suited to their condition in life. He was pleased with the suggestion and authorized me to select one dozen, then fourteen, then he increased the number to twenty. William A. Jones, President of the State Normal School, was my aid. We chose, chiefly, such as promised well but were not able to complete the course without aid.

In time I suggested to him the desirability of securing a building for a boarding house, which with furnishing would not cost more than $20,000, and giving an endowment of $100,000, in aid of deserving young ladies who could not pay their way. He acceded to the proposition on condition that the State should pay one-half the cost of the building, and authorized the Board of Trustees to say that much to the Governor and State Legislature in their next report. It turned out that no official notice was taken of this proposition, unless it was a paragraph in the Governor's message. He became disgusted with their lack of appreciation and his mind underwent a change.

When I next saw him he told me he had lost faith in public officers and politicians. Changes in parties imperiled finances and he did not want to leave his money in the control of State authorities or trustees. He preferred private incorporations who are empowered with self-perpetuity. He had been thinking much about business men who are good workmen, but can not prepare their estimates, drawings and specifications and have to be running to lawyers and architects. If he could do something for them he would like to do so. I informed him what he wanted was a polytechnic school. I had visited several in the East, and especially one at Worcester, Mass., which gave a full and complete scientific training to boys, practically fitting them for business men; and if he desired me I would write to Prof. Thompson for some reports which would give him a correct idea of the purpose and working of such an institution. After examination of these his mind fully settled on the endowment of a polytechnic school and on the erection of a building. His will was then made, specifying his bequest, which he read to me. I think very likely Josephus Collett, the presiding officer of the Board, whose head is ever full of practical ideas, had also a leading part in formulating his thoughts and purposes.

A Board of Trustees was chosen, a Constitution and By-Laws drawn up, an organization completed and a seal approved and ordered to be made, Chauncey Rose being President of the Board. An occurrence created no little amusement when it was discovered that nearly all the Board were bachelors. We must not, however, reflect on them. I well remember finding a very worthy old gentleman in England, who had never been married, in a good comfortable home with a hired housekeeper. I deprecated his lot in a conversation with an estimable lady. "Oh," she said, "I presume he is not to blame for it." Our fortunes are not all alike in life. The poet Whittier tells us of the sweet little girl who hated to go above him in the spelling class at school, over whose beautiful form the grass has been growing for more than forty years. No, do not reflect upon bachelors. How do we

know but that more of them are preparing to make further endowment bequests to polytechnic schools.

At the suggestion of Chauncey Rose, while I was in New England, I was requested to inquire of Prof. Thompson for some talented student who had passed under his training and who had skill and fitness for such a place. When that result was almost achieved there was a suspension of operations by the death of Chauncey Rose.

When an advance movement was resumed, I was agreeably surprised to find that, like Miles Standish's courtship, the Board instead of taking the man President Thompson had recommended took the President himself, and it now so turns out that we have for the Rose Polytechnic Institute the leading educator in technical science in America to give it rank among the best in the world.

I desire before I close to say that we ought not to stop in this enterprise where we are. The girls need polytechnic schools as well as the boys. They need to know how to cook scientifically. There is scientific taste and method in good ventilation, neatness. Health and science are co-ordinates of a system. Every girl should know how to cut and make her own dresses. Indeed, I question whether a young lady should be allowed to marry if she could not stand a successful examination on these subjects.

You may have seen a notice of some French ladies who had lately been inspecting schools in America, and had been at Vassar and inquired of the young ladies what attention they gave to cooking, and housekeeping, and cutting and making. "None," was their answer, "We have domestics to do such things." The visitors laughed outright at the absurdity of young housewives superintending cooking, housekeeping and seamstresses when they are unacquainted with the work they are doing.

Let us hope and look for the day when our girls will be able wisely and intelligently to attend to the kitchen and household interests and to cut and make their own dresses. We need professional scientific schools for girls as well as for the boys for the completeness of an educational system.

After music by the orchestra, Rev. Mr. Croft pronounced the benediction and the audience dispersed.

IV.

Inaugural Address by President Homer T. Fuller, Ph. D.

"The Present Place and Work of Technical Schools.*

The technical school, as we now know it, is the outgrowth of modern civilization, especially of modern invention and wide-spread competition. Let us briefly note the beginnings and the progress of its work. Up to the present century, except for military purposes, in no civilized country has there been special, systematic public training for business or the arts. Great public works involving stern conflict with the forces of nature were not attempted. The first military school, the famous Ecole Polytechnique at Paris, was established in 1795. It embraced in its plan something of civic construction. Napoleon said it was the hen that laid him golden eggs. The engineers it trained have few laurels from the common historian, but they bridged for their sire many a mighty river, and robbed the Alps of their terror for soldier and civilian.

TECHNICAL SCHOOLS IN FRANCE.

Schools of arts and trades in France were founded but a little later—at Chalons in 1802, at Angers in 1811, and a third at Aix in 1843. These train foremen and skillful workmen, master-finishers, founders, blacksmiths and machinists. Pupils are admitted at 16 years, after a common school education. They work seven and a half hours in the shop, and five and a half hours daily in classes and in drawing. "The chief advantage of these schools is not their direct influence on labor, but they serve as standards of comparison. They supply good overseers, but the theoretical studies are not sufficient to form skillful engineers." Hence, in 1829, was established the celebrated Ecole Centrale, or higher technical school in Paris which educates engineers and superintendents of machine shops and manufactories. It has courses on mechanics, civil engineering, chemistry, metallurgy and architecture, covering three years, and its requisites for admission include the elements of

*An Inaugural Address by Homer T. Fuller, Ph. D., Principal of the Worcester Free Institute. June 28, 1883. Worcester, Mass. E. C. Stone, printer and publisher, 1883, pp. 17.

physical science, and mathematics through descriptive and analytical geometry. Other technical and many apprentice schools, with shops for wood and iron work, exist in Paris, and other cities of France, and there is an increasing demand for them. Paris alone has one hundred art schools free to both residents and foreigners.

TECHNICAL SCHOOLS IN GERMANY.

Germany has eight polytechnic schools of the high grade of the Ecole Centrale. The courses are four years in length, and the preparation, Greek being omitted, corresponds very nearly with the attainments made in our better American colleges at the end of the sophomore year. Austria has seven such schools, Switzerland one, and Italy three, each of them instructing from six hundred to one thousand students. At Berlin will be opened in October next a new building for the Polytechnic of that city, which is the largest and finest single school edifice in the world. It will easily accommodate four thousand students, and has a separate chemical laboratory where four hundred and twenty can practice at once. These buildings, with furnishings, will cost two millions of dollars.

The oldest technical school in Germany was founded at Augsburg about 1806, and the Bavarian system of which it forms a part is regarded as more symmetrical and complete than that of any other European nation, unless we except Italy, which has adopted substantially the Bavarian method. It provides technical instruction in two grades of schools. After a preparatory course, which includes Latin, French and English, and mathematics through a part of analytical geometry, the young man enters an industrial school, where he has higher mathematics, physical science, with practice in laboratory, English and French, drawing and designing for two years. If he chooses the mechanical department, he has shop practice at the vise and bench, and a limited amount of machine work nine hours weekly. There are four such industrial schools in that small kingdom, and the graduate from them can then enter the Polytechnic at Munich, and pursue for four years longer, theoretically and experimentally, the studies of the department he has chosen.

INDUSTRIAL SCHOOLS IN EUROPE.

Industrial and scientific schools of a lower grade are in all the central states of Europe, numerous and varied in character. Germany has three mining schools, four of forestry, others for general agriculture, for grape culture, for weaving and dyeing, and for theoretical instruction in almost every kind of trade and business. These are mainly supported by the state or city, and are open to citizens and strangers upon payment of merely nominal fees. Besides those schools which provide regular and continuous courses of study for the young, there are opened from November to March winter schools for laborers and other persons. These are sometimes day schools, sometimes evening schools, according to the occupations of the people and the time they can devote to study. In some regions there are many distinct and separate industrial schools, as in the vicinity of Frankfort-on-the-Main, where, within a radius of thirty miles, may be counted nearly a score of them. In large commercial cities instruction in a great variety of subjects is given under the same roof. Hamburg, for example, has a scientific and trade school, whose rooms are occupied constantly from 8 o'clock A. M., till 10 P. M. Eighty teachers give instruction to several thousand pupils of all ages from twelve to sixty years. No one there thinks himself too old to study. Nobody is too proud to confess ignorance and avow thirst for knowledge.

INCREASE OF TECHNICAL SCHOOLS IN GERMANY.

Without being able to give exact statistics, I am quite sure that the provision for instruction and for appliances in technical work has increased in Germany more than twofold in the last fifteen years. What has been the result of this scheme of almost universal industrial training? Chiefly, the direct and enormous development of manufactures. Fifteen years ago England manufactured cotton, woolen and other goods very largely for German trade; to-day Germany imports cotton from the United States, and sells the product at a profit in the streets of Birmingham and Manchester, of New York and Worcester. Fifteen years ago Nottingham, England, made cotton gloves, hosiery and coarse laces for the world; within five years, so I am told, twelve of the largest firms of Nottingham have moved their machinery and fixtures to Chemnitz in Saxony, and have found that the skilled, educated labor of that inland, mountain city was much more profitable to them than any they could employ in sea-girt England, even though the multitudes of the latter were almost starving for lack of work. This same Chemnitz exports larger values to this country annually than any other European city, with, perhaps, four or five exceptions. It has a population not greatly above that of our own city, but in it, with the best provision for general education, are three distinct higher technical schools, and two

trade schools, all of such efficiency and celebrity as to attract the attention of technologists throughout the world.

INDUSTRIAL SCHOOLS IN RUSSIA.

Other states of Europe have been following the example of those already mentioned. Russia has had for years two great mechanical schools, one of them at Moscow, an immense establishment, conducted on the plan of our own school, and she is now organizing apprentice schools, and other technical schools of an intermediate grade. Sweden, Denmark, Holland and Belgium have schools scarcely inferior, nay, in some regards superior, to those of Germany and France, while Spain and Portugal, though far behind, have entered the list to contest the prizes of civic industry.

CAUSES WHICH LED TO THE BRITISH SCIENTIFIC AND TECHNICAL COMMISSIONS.

There is no doubt that recent international expositions by the opportunities afforded of the comparison of fabrics have had a considerable influence in impressing, if not determining, the value of special education for industrial pursuits. Prof. Rouleaux of Berlin went home from Sydney to report that certain German fabrics were often inferior in quality. His people needed better machinery, and more skill and care in manufacture, and, beginning at home, he insisted on practice as an important element of instruction in mechanical engineering. At Paris, in 1878, the English commissioners found that even in woolen and worsted work the English had failed to maintain their former superiority, and when they discovered, a little later, that their own pig-iron was taken over to Belgium and wrought into steel and machinery more satisfactorily than it could be done at home, parliament moved for a royal technical commission to inquire into the causes and remedies. This commission entered upon its work in August, 1881. They have visited most of the best technical schools on the continent, and have reported that in largely increased and improved facilities for technical education alone lay hope of resuscitating the waning industrial fortunes of the kingdom. Meanwhile, private enterprise did not wait for the tardy action of great official bodies. Since five years ago, a single individual has founded and partly endowed the Mason Science College at Birmingham, at a cost of nearly half a million dollars. A new technical school at Bradford has been built by subscription. Older schools at Manchester, Bristol, Sheffield and Leeds have been put on better footing. University and King's Colleges in London, with laboratories and workshops, are giving their attention largely to scientific and technical work. Nottingham is converting its university into a place for similar training, and even old and aristocratic Eton, heretofore intensely classical and more the school of the nobility than almost any other in England, has created a scientific course of study and built workshops where its students may learn and practice a variety of trades. In London during the last twelve months two technical schools, one quite new, have erected commodious buildings, and the trade companies of the city have in addition subscribed $100,000 for the current annual expenses of these and other provincial schools. These facts show the trend of the times abroad. Did time permit I might mention others which I have known or verified by personal observation. In the interval of three years between my two visits, and careful studies of European schools of almost every grade, there has been very marked progress in technical and industrial training. England has doubled its outlay for this purpose within that brief time, and no one who has not been on the ground has any adequate conception of the intense interest now taken there in this form of education.

It is no exaggeration to say that this subject is just now the foremost educational topic of the world, and that those states or communities that fifteen, or ten, or even five years ago did the best work then demanded, and rested there, have seen, or will soon see, other nations and cities outstripping them if they do not keep pace with the advance.*

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*How much in our own country has been done since this Institute began its work may be seen from the dates of organization of the following schools, and the amount of funds contributed to each by private liberality.

Stevens Institute of Technology, Hoboken, N. J.	1871,	$650,000
Miller School, Batesville, Va.	1878,	1,000,000
Towne Scientific School, Philadelphia	1872,	1,000,000
Pardee Scientific Department, Lafayette Coll., Easton, Pa.	1873,	500,000
John C. Green's School of Science, Princeton, N. J	1873, over	400,000
Case School of Applied Science, Cleveland, O.	1881,	1,250,000
Rose Polytechnic Institute, Terre Haute, Ind.	1883, over	500,000

These are only a few of the whole number that might be mentioned.

THE DEMAND FOR HIGH CLASS TECHNICAL TRAINING.

2. The second consideration worthy of special note is that technical schools are coming more and more to be relied on to meet the demand for intelligent and skilled labor and superintendence. It is true both in Europe and this country. The business men of this land long ago found it to their advantage to employ in manufactures, mining, engineering and allied pursuits men who were trained in the principles of these sciences. And since our own schools failed to meet the demands, we have imported men or sent our sons abroad to be educated. For some of our finest public works we are indebted to the training of foreign technical schools. Mr. Ellet, who built the first wire suspension bridge in this country, over the Schuylkill at Philadelphia, and who first spanned Niagara, studied in Paris, and the elder Roebling, the architect of the Niagara railway bridge, and designer of the stupendous structure, just completed, which swings multitudes high over the masts and sails of crowded shipping between Brooklyn and New York, was a graduate of the Berlin Polytechnic. In September last the head of the Technical School in Bradford, England, said to me, "I have just lost my most valuable assistant. He has been enticed away to a mill in Philadelphia." Indeed, in a single manufactory in this city of Worcester, there are employed, in important work requiring great skill, four men who are graduates of foreign technical schools. The same is true of chemists and engineers, and experts in many others of our manufacturing centres.

AMERICA MUST SUPPLY THE AMERICAN DEMAND.

What, my friends, is the logic of these facts? Our corporations and private firms find this technical training valuable, yes, indispensable. Not even now do our own schools, for all forms of work, and especially for the higher grades, nearly meet the demand. Shall we continue to draw from the schools of Europe? We can not many of us send our sons thither to be educated. If we could, it were still doubtful policy. Shall we let our children grow up idle and unintelligent, and hire aliens to do our best work? Then we invite supplanters. For those who do most skillful work will sooner or later own the capital. The most of us hereabouts believe in the protection of American industry. But that phrase, "American industry," is susceptible of more than one interpretation. Does it mean a simple advantage to the *capital* invested in our industries? But, what if a fortune be accumulated in one generation, only to be squandered in the next? What avails it if our children have money, and fail to learn its value and its best use? Or, does the protection of American industry mean special advantage to the present generation of laborers? But what is the advantage in the end, if children are not trained to habits of industry, are not fitted to succeed the fathers? If our own sons are not as well equipped as those of foreign birth and culture, they will eventually lose in the race, and be despoiled of their rightful heritage. It is but simple justice to our own that we give them the best possible preparation for the work of the future. The interests of capital and labor in the long run are not separable. Protection to one is protection to the other. But protection in the broadest sense should mean protection to the American boy, and we should be ashamed to confess that he cannot be educated in most of the principles and applications of modern science, as well at home as anywhere else in the world.

We in this country cannot slavishly imitate foreign systems of education. We must create or adapt our systems to our people and to the industries we would foster. We need a variety of schools to suit the widely varying demands of business, the diverse interests of different sections of the country, and the tastes and capacities of those who must receive instruction. But we greatly mistake, if we think we are well enough off as we are, if we suppose that our smartness is sufficient for all things, if we imagine that nothing is to be learned from those who for scores of years have been doing substantially what we have just begun to do.

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GENERAL CULTURE AN ESSENTIAL OF HIGH CLASS TECHNICAL EDUCATION.

Finally, we do not forget that the work of a school like this must seek to unite with special training the utmost possible general culture. We cannot in this land, in harmony with republican principles or consistently with the attainment of the purpose of technical training, divorce general culture and practical skill. Either alone tends to narrowness. The one ends in mechanical repetition; the other, in vapid talk or empty speculation. The testimony, not only of educators, but also of engineers, is emphatic on this point. Says Dr. R. W. Raymond, editor of the Engineering and Mining Journal, "the more one observes of the careers of men about him and the more one wrestles with the difficulties of one's own, the more

profound becomes the conviction that a young man makes a great mistake who, because he is going to take a technical education in engineering, deliberately decides that he will not have any general culture to begin on," and in a recent address before the American Institute of Mining Engineers, President Holley had this utterance: "It is useless to disguise the fact that the want, not of high scholarship, but of liberal and general education, is to-day the greatest of all embarrassments which the majority of engineering experts and managers encounter."

How much of this culture shall precede the technical course, or just how much shall be incorporated in it, is a question which must from time to time require a varying answer. We must have enough in the course, or before it, to make the most of the man, certainly enough in the course to secure a steady and healthy intellectual and moral growth. The atmosphere of these rooms should be one, not of content, but of aspiration, and the impulse to broad and generous thinking, to high attainments in science and the arts, and, above all, to a pure and noble Christian living, be so strong that it shall abide to the end of the days of every one who graduates from these halls.

APPENDIX Y.

TECHNICAL TRAINING IN INDUSTRIAL PURSUITS.

I. Introduction.

II. Report on Technical Industrial Education with accompanying papers, made by Dr. W. T. Barnard, Assistant to the President, to Mr. Robert Garrett, President of the Baltimore and Ohio Railroad Company.

APPENDIX Y.

ON TECHNICAL TRAINING IN INDUSTRIAL PURSUITS.

I.

INTRODUCTION.

This Appendix comprises a large part of the important and comprehensive report, made in 1886, by the late Dr. W. T. Barnard, recently deceased, (1895), to President Garrett, of the B. & O. R. R. Company. Dr. Barnard, was, at that time, connected with this company as "Assistant to the President," and it was primarily with the purpose of inducing the establishment of a Technical School, at Mt. Clare, near Baltimore, Maryland, in connection with the works of the company there situated, in which a corps of intelligent and skilled Railway mechanics, engineers, and employees, could be trained, that the preparation of this admirable paper, with the accompanying "Exhibits," showing the value of definite technical training in all industrial pursuits, was undertaken. Unfortunately, owing to changes in the personnel of the officials of the B. and O. Company, with the retirement of Mr. Garrett from the Presidency, this experimental school, begun under such favoring conditions, had but a brief existence, comprising only two short years of active operation. The account of the origin and work of this pioneer school is to be found in Chapter V. of the present volume of this Report. (See *ante* pages 129–170.) A concise statement concerning the labor expended in the preparation of Dr. Barnard's report is there given. As the outcome of careful study, by competent authorities, of European and American institutions and experiments in the direction of Technical Industrial Education and Training, this report will be found of value to those interested in investigating the industrial and educational tendencies of the present age.

The few words prefaced to the report by Dr. Barnard, show that he looked upon it as relating to the whole subject of Technical Education in all Industrial Pursuits; and by no means as limited merely to Railway interests. It is because of this wide embracing survey of Technological Educational activity, that so much of this very interesting and valuable report finds place here.

At the possible risk of some little repetition, the notices of a few European institutions, which may have found place in other papers in some of the various Appendices to this Report; as well as the concise statements of a few leading Technological Schools, as given in the text, or "Exhibits," of Dr. Barnard's report, are retained. The number of similar high grade polytechnic institutions in the United States is not as yet so large as to render us indifferent to what other countries, our industrial competitors, may be doing in the matter of providing for the higher technical training of their people. Accounts of a number of European Industrial Art Training Schools are included in the Appendices to Part III. of this Report.

The view taken by Dr. Barnard, of the relation which the Johns Hopkins University might, and as he contends should, bear to the free public schools of the City;—namely: to be the head and crown of the City's system of free public education,—and the direct influence this institution of higher learning could, if it should so elect, so happily exert upon the industrial training of the people, is somewhat novel as well as most suggestive.

In showing that the great fortune of Johns Hopkins was invested in the B. & O. R. R. Co. and that so large a portion of the income of the University comes from that company, he traces a connection between the University and the B. & O. R. R. company, which, in his opinion, justifies his remarks: and is, he thinks, sufficient to amply justify the authorities of the University in initiating practical elementary technological training for the graduates of the public schools of Baltimore, on a large scale.*

If this university should enter on this field and undertake this great work, without in any degree lessening its present activity in the higher work of original research and initiation, in which lies the peculiar province of a University as differenced from other educational institutions,—it would do more, than in any other possible way, for popularizing higher education; by awakening the interest of the people, as a whole, in an institution, whose beneficence was not limited to a narrow and special class; but which, like a life-giving Sun, shed its light and warmth on a world of workers.

In his comments upon contemporary conditions in the City of Baltimore, and on the rapid loss of certain of the former industries and sources of prosperity of the City, and in his illustrations showing how some other communities have succeeded in retaining and improving old, or in creating new sources of industrial prosperity there is, in Dr. Barnard's method of marshalling his statistics, much of significance. One of the most striking points made is the showing of the very small number of persons, as compared with the entire population of the city of Baltimore, who can possibly be trained, annually, in any practical industrial and technological knowledge; even if all the facilities of the City Manual Training School, The Day and Night classes of The Maryland Institute, The McDonough School, and the present facilities for higher technical training in the Laboratories and lecture rooms of the Johns Hopkins University, should be availed of to their utmost capacity. This feature of his references to local matters in Baltimore has led me, contrary to my first intention, to retain this part of the report because, it is only by the study of such comparative statistics as applied to the population in our American towns and cities, that we can come to any realizing comprehension of the appalling lack of opportunities existing in the United States, for the thorough training of American youth in any form of technical, or artistic, industries. Such facts emphasize the importance of introducing in all our public schools, so much of elementary training in Drawing, and Industries, as may be found possible.

As is somewhat unusual with theoretical writers on educational topics, Dr. Barnard, and his co-adjutors, were brought in immediate contact with a large population, whose working members were

*The subsequent transferring of the funds of the University from the B. & O. R. R. securities to other forms of investment, renders these particular arguments irrelevant, but in nowise diminishes the force of his suggestions as to the desirable relations of the University to the City school system.

engaged in a special industry; and thus were made aware, by personal observation, of their educational deficiencies and needs. The account as given of the low estimate in which even the most elementary education was held among these settlements of B. & O. R. R. employees, and of the causes of this indifference, is very striking. (See *ante*, Chapter V.)

This experience gave to Dr. Barnard a fuller realization, than is possessed by many even of the professional advocates of Manual Training, of the pressing need that exists for the immediate extension of elementary industrial and technical training among the children of the people. He writes with the earnestness of enthusiasm, the soberness of conviction, and the confidence of knowledge.

The importance of the detailed statements of the advantages that would accrue to the Rail Roads, if they could command the aid of educated and skilled workers in every department of their service, which were indeed especially suited to the purpose of this particular report,—designed to convince the President and Directors of a great Rail Road corporation, of the wisdom and expediency of establishing a technical training school for the Apprentices of the Road,—is not confined to any single Corporation or Industry; *Mutatis mutandis*, the arguments are equally valid when applied to any industries or undertakings where skill is needed; to any employers of workmen in factories; or to any town or city corporation, which has public buildings, bridges, and highways, to provide and care for. The doctrine of the conservation of force is all-embracing in its application, and the resources and energies of a corporation, or a community, are to be husbanded as carefully and expended as judiciously, as those of an individual; and this can only be done by men of trained and skilled experience.

Although these words about Dr. Barnard's report are written in June, 1895,—nine years later than the publication of that report, still it is believed that the *ratio* of the number of Institutions affording opportunities for technical industrial training, to the whole population of the country, remains, owing to the increase of population, about as it was when Dr. Barnard wrote; and, therefore, his lessons, comments, and suggestions, are as applicable to present conditions and as worthy of consideration by all interested in the educational prosperity of the people, as when first published.

However, the natural inference from the above statement, namely: that there had been *no* progress in the development and extension of opportunities for Technical Industrial Training, or in the interest taken by the public in such educational methods, would be misleading; for there has undoubtedly been in many communities, since that report was written, a steady growth of that public opinion which demands the putting of Manual Training, and Training in Domestic Industries, in the higher grades; while there is a very general demand, growing with each year, that "Drawing, as a required study," shall be taught, in some of its forms, in each and all grades of the Public Schools.

Nor would it be proper in even the most cursory account of the present condition of Technical Industrial Education in the United States, to omit to state that, during the nine years that have elapsed since the publication of this report by Dr. Barnard, three admirable and fully equipped Industrial and Technical Institutions of high grade, founded by liberal individual Philanthropists in different

cities, have been opened to the public. These are: The Pratt Institute, of Brooklyn, opened in 1887; The Drexel Institute, of Philadelphia, opened in December, 1891, and The Armour Institute, of Chicago, opened in 1894.*

Valuable as are these institutions, regarded as an addition to the educational facilities of the people, and desirable as has been the growing public interest in the introduction of elementary industrial and artistic training in the public schools, it would be a grave mistake to conclude that, since so much has been accomplished, there is no further need for anxiety.—"Eternal vigilance is the price," not only of "Liberty" but also of Progress; and, with our ever increasing population and annual swarms of untaught children besieging the school room doors, the need for that form of training for which Dr. Barnard pleads, is as pressing to day as when he wrote.—In fact, with each passing year, it becomes ever more pressing; because Inventions and Scientific Discoveries advance with such rapid strides that occupations become useless almost before they can be acquired. Dr. Barnard, has called attention to the fact that in the shops of the older R. R. companies, the old patterns and models, so rapidly become obsolete that this item alone, is a source of expense and a cause of inferiority. This is equally true in many other manufacturing and mechanical Industries.

The marvellous developments of the myriad applications of electricity create ever new demands for skill; while the many new industries, evoked by discoveries in science, make like demands. The only hope for the coming race of workers lies in the prevalence of more thorough scientific and technical training, to give to mens minds, such breadth and quickness of comprehension; and to their hands, such skill of manipulation; as will suffice to enable them readily to adapt themselves to the new and ever changing conditions. To compose machines from their scattered machine-made members and parts, and to manage and direct the operations of machines, instead of the making of tools, or objects, by hand; would seem to be the coming employment of the majority of skilled workers in the near future. For such duties, a higher degree of skill, a greater grasp of mind is requisite, than when, as not long since, the whole working life of many an artizan was passed in making, or polishing, the same single unrelated part of a machine, or the portion of a tool; such, for example, as the oft quoted instance of the employment of numbers of workers in the grinding of the point of a needle. In this day of electric motors and of bicycles,—an era as pregnant with change as was that of the introduction of steam, and which like that, will compel many and far-reaching changes in industries, and the creating of numberless new mechanical contrivances;—the following arguments urged by Dr. Barnard, both for the elementary and advanced technical training of the people, appeal with added force.

*The two first will be found fully described in the preceding volume of this Report. (See Part III., pages 448–609.) The "Armour Institute" was founded too recently to find place in the body of either Part III or IV. of this Report; since the pages are stereotyped as soon as proof read. A concise account of this new institution is, however, given in the final Appendix to Part III. As the authorship and compilation of the material of these volumes, and the author's proof reading, is wholly the work of a single person, there is, of necessity, a considerable lapse of time between the first page of Chapter I. and the final page of the Index of the large volumes which make up this Report.

BALTIMORE AND OHIO RAILROAD COMPANY.

SERVICE REPORT ON TECHNICAL EDUCATION, WITH SPECIAL REFERENCE TO BALTIMORE & OHIO R. R. SERVICE. *

By DR. W. T. BARNARD, ASSISTANT TO THE PRESIDENT.

BALTIMORE, *October 1st*, 1886.

Mr. ROBERT GARRETT,
President Baltimore & Ohio Railroad Company.

SIR: June 7th, 1881, the General Counsel of the Baltimore & Ohio Railroad Company invited your attention to a scholarly and thoughtful address on technical education, delivered before the Maryland Institute, June 4th, by Hon. S. Teackle Wallis, and, referring especially to so much thereof as related to the establishment in Baltimore of a technical school for scientific and mechanical instruction, Mr. Cowen said:

I have always thought that the Baltimore & Ohio Railroad Company did not have enough of educated talent in its service, and that, among its artisans and mechanics, there should be more scientific knowledge than can now be found in our various departments.

It strikes me that there is no one in the city so much interested in the establishment of such a school as Mr. Wallis indicates in connection with the Maryland Institute as the Baltimore & Ohio Railroad Company.

I presume you have a hundred or more apprentices at Mount Clare, and have thousands of artisans along your entire road, who should have received a first-class education at some technological school, who have never received any such education at any place of instruction, and have simply an empirical knowledge gained from practical work.

As Mr. Wallis justly says, the "practical man," so called, has had his day, and is fast going to the wall under the law of the "survival of the fittest."

On all mechanical subjects there is an amount of learning which can be obtained from schools, and cannot be obtained in any other way, and beyond question the Railroad Company should endeavor to avail itself of the class of men who have had this early training.

There is no way in which this could be so well done as by having a competent technological school in the city, the students of which could be taken into our service from time to time, and would certainly elevate it very much by the application of the learning derived from skilled instructors.

I wish you would look at the subject, both as an officer and a citizen, and see whether there is any way in which you can aid in the establishment of such a place of instruction for the deserving artisans and mechanics of the city.

NO RECORD OF EARLIER CONSIDERATION OF TECHNICAL EDUCATION FOR B. & O. EMPLOYES.

A careful search amongst the voluminous records of this Company fails to show that the necessity for a higher standard of qualifications for its operatives had, before this communication, found official expression, even if it had engaged the attention of the Company's officers. Indeed, technical education in mechanic arts had then but slightly attracted public attention in this country, except locally and as the result of endowed institutions for combined scientific and manual training, such as the schools at Worcester, Troy, Boston, Hoboken, *et al.;* this notwithstanding the fact that, as early as July 2d, 1862, Congress—contemplating especially the promotion of practical education of the producing classes—had made liberal grants of land to the several States in aid of the establishment of schools for scientific instruction in agriculture and mechanical pursuits.

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*This pamphlet report was printed with the following preface.

PREFACE.

The solicitations of several prominent citizens of Baltimore, earnestly interested in its welfare, and of other friends specially concerned in the development of our American railroad system, who, after examining the manuscript of this report, believed that the data therein contained would materially and beneficially affect the educational work of Baltimore and of our railways generally, have determined me to give these pages a wider circulation than merely among the officials of the Baltimore and Ohio Railroad Company, for whose information they were primarily written.

In doing this I should much prefer re-arranging this data, so that the publication might show no relation whatever to the Baltimore and Ohio Railroad Company, but other demands upon my time prevent this revision. Though, for this reason, material collected for my own purposes and deductions therefrom are embodied in an official report, it is to be distinctly understood that no one but the writer stands committed to the statements or views therein contained; the responsibility for which he, as a private citizen, solely accepts.

W. T. BARNARD.

VICE-PRESIDENT GARRETT CALLS FOR SPECIAL INVESTIGATION AND REPORT UPON THE PRACTICABILITY OF TECHNICALLY EDUCATING R. R. EMPLOYES.

Some time subsequently you requested me to make this subject—thus forcibly brought to your notice—one of special investigation and recommendation. My time being then wholly occupied in organizing the Relief Association, I was not able, at the moment, to give it more than cursory and casual consideration, except as to some special points upon which reports were, from time to time, rendered—*e. g.*, upon the necessity for a laboratory for testing raw and manufactured materials used in construction, and for experimental work in engineering and in mechanical physics—resulting in the establishment of the chemical and physical laboratory at Mt. Clare. Meanwhile our present Vice-President, Mr. Samuel Spencer, having been assigned to the direction of the physical operations of the service, was enabled to correct many (and to favorably influence other) practices which were operating detrimentally to the Company's interests; so that there seemed to be no special urgency for this report.

Since retiring from the executive management of the Relief Association I have, as press of other engagements permitted, given the subject of technical education IN ITS RELATION TO RAILWAY SERVICE "*the special investigation and study*" you requested, and herewith submit, as briefly as its importance permits, the results of my labors.

ESTABLISHMENT OF TECHNICAL CLASS INSTRUCTION OF APPRENTICES AT MT. CLARE.

Also, at an earlier date, taking advantage of the erection of a new passenger-car shop at Mt. Clare, I recommended that sufficient space be included in its outbuildings to serve temporarily as class-rooms for the theoretical instruction of apprentices, and, having been so provided, those rooms are now utilized for the Employes' Circulating Library, and for instructing classes of apprentices in accordance with the program announced in your Executive Order No. 6, of January 15th, 1885, hereto appended [Exhibit A], which was designed to be initiatory of the plan of instruction recommended in this report.

REVOLUTION IN TRADE RELATIONS CAUSED BY TECHNOLOGICAL EDUCATION.

At the threshold of an inquiry into the status of technical education at the present day, the investigator will be astonished no less at the magnitude of the subject than at the revolution it has caused in the trade relations between competing sections of the same, and between different, countries; always in favor of those utilizing its efficient aid.

INTEREST TAKEN IN IT IN ENGLAND, GERMANY, ETC.

One has only to peruse, in the leading English and Continental newspapers and periodicals, the legislative debates, governmental, municipal and trade reports and editorials on this subject, constantly published, to realize the overshadowing importance which, in Europe, is now attached to technical instruction, not only by manufacturing and commercial interests directly affected by it, but perhaps to a greater degree by the foremost statesmen and political economists of the day; as witness the writings of such noted authorities as Professors Huxley, Ayrton, Siemens, Kennedy, Solly, *et al.*, the debates in Parliament, and the attempts of Prince Bismarck, of Germany, of Lord Salisbury and other English treasury officials, to solve, through its agency, the great social problems affecting the masses of their densely populated countries.

CHARACTER OF INVESTIGATION INTO STATUS OF TECHNICAL INSTRUCTION.

In order to acquire such thorough knowledge of what has been, and is being, done in this field as would enable me to make intelligently the recommendations called for, it became necessary to study an extensive literature, and also, by inspection of home and foreign schools, by personal investigation among the principals and workmen of those accessible corporations and firms enforcing technical instruction of a practical character, and by witnessing their methods of applying it, to determine its economic results. In this work I was ably assisted by Messrs. C. W. Scribner and G. P. Coler, who, upon the inauguration of class instruction for apprentices, were appointed instructors at Mt. Clare.

INSTITUTIONS FOR TECHNICAL EDUCATION IN AMERICA INVESTIGATED.

The principal schools and places visited and inspected in the performance of this duty were: Stevens Institute, Hoboken, N. J.; Massachusetts Institute of Technology, Boston, Mass.; Worcester Free Institute, Worcester, Mass.; Columbia College, N. Y.; Cooper Union, N. Y.; Philadelphia Manual Training School, Philadelphia; Spring Garden Institute, Philadelphia; Chicago Manual Training School, Chicago; Maryland Institute, Baltimore; Baltimore Manual Training School, Baltimore.

INSTITUTIONS FOR TECHNICAL EDUCATION IN EUROPE INVESTIGATED.

Abroad, at London, the Central Institution of City and Guilds of London Institute, Finsbury College, Young Men's Polytechnic Institute and the Birbeck Institute; at Manchester, Mather & Platt's Workshop School, Owens College and the Manchester Technical School; at Oldham, the School of Science and Art; at Leeds, Yorkshire College; at Newcastle, the Elswick School of Science, connected with the extensive works of Sir William Armstrong & Co.; at Bradford, the Bradford Technical College; at Nottingham, the University College and the People's College; at Glasgow, the College of Science and Art, Allan Glen's Institution and Anderson's College; at Edinburgh, the Science and Art Museum; at Crewe, the Science School of the London & Northwestern Railway Company; at Paris, the School of Arts and Trades; at Nuremberg, the Royal Industrial School; at Munich, the Royal Industrial School and the Polytechnic School; at Zurich, the Polytechnic School; at Mulhouse, the Trades School, the Professional School and the School for Spinners and Weavers.

BASIS ON WHICH RECOMMENDATIONS AND CONCLUSIONS HEREIN CONTAINED WERE REACHED.

It is therefore to be understood that the recommendations herein contained for the application of technical instruction to our own service are founded on careful investigation and study of technical institutions at home and abroad. Recognizing that a more forcible and conclusive presentation of such a complex subject would be secured by the citation of pertinent facts and conclusions reported by or drawn from the experience of those who, by reason of special training, study or unusual facilities of observation, are acknowledged to be competent authority on the subject, rather than by advancing personal views, I have, in the preparation of this paper, freely used parliamentary and U. S. Governmental reports, and other authoritative publications on technical instruction.

VITAL IMPORTANCE OF TECHNICAL EDUCATION TO GENERAL INDUSTRIAL AND COMMERCIAL INTERESTS.

Our researches—which, it will be noticed, have compassed a broad field—have so impressed me with the vital importance of technical education, not only to the B. & O. Company, but to other industrial and commercial interests of Baltimore, and the United States in general, and with the almost universal ignorance of its potency displayed by those in our community whom it would most beneficially affect, that I have deemed it a duty to collate the salient results of our labors into a form that may possibly exert a favorable influence upon other interests besides that in whose behalf those labors were undertaken. To do this effectively such a report must take a much wider range than was originally contemplated, and even then the magnitude of the subject is such that it can only be considered a *sketch;* but it is hoped its matter will compensate those interested in the subject for its length: the uninterested would not peruse a less elaborate statement.

CHARACTER AND SCOPE OF THIS REPORT.

For obvious reasons this report is divided into, first, a sketch of the effects of technical education in Europe; second, a review of its progress and present status in the United States; the third part will show the need of more thorough and extended technical instruction in Baltimore; the fourth, the advantages which the B. & O. Company, in common with other railway interests, would derive from a thorough system of this character; and the fifth offers a program for inaugurating systematic technical instruction in our service.

Effects of Technical Instruction in Europe.

TECHNICAL EDUCATION FORCED INTO PROMINENCE, IN EUROPE, BY TRADE COMPETITION.

In Europe the necessity of technical education for industrial laborers, felt and freely acknowledged many years ago, was forced into prominence through the increasing rivalry between manufacturers and other producers competing with like articles in the same markets. In order to counterbalance the advantages some engaged in a given industry enjoyed through the possession of cheaper raw material, labor, prestige or favorable situation, their competitors of foreign—and even of the same—nationality were compelled to look to improved methods of manufacture or production for ability to hold their own, and were thus brought to realize that educated labor and technical skill were the soundest elements with which to defend themselves in trade competition, in that they promote excellence of execution, inventiveness, enterprise, and all the qualities required to successfully conduct progressive industries.

NATIONAL TECHNOLOGICAL EDUCATION IN EUROPE.

Under this pressure producers and manufacturers, through their guilds and other associations, were soon able to exert an influence upon their governments which has resulted in every European nation's making greater or less provision for public industrial education; until at this time not only England, France, Germany, Austria, Switzerland, Holland and Italy, but all the minor Continental States, have their governmental schools for both elementary and higher technical instruction; and even Russia—so far behind all other nations of Europe in elementary education—has found it necessary, in order to maintain her home industries, to make quite liberal provision for the maintenance of mechanical and manufacturing schools, and has established two great Imperial technical institutes—one at St. Petersburg and the other at Moscow—which are classed as amongst the finest in Europe in point of equipment and ample means. The encouragement which that government is giving industrial education has been supplemented by the action of leading Russian railroads, which have established schools for their people at their principal works.

ELEMENTARY SCIENTIFIC EDUCATION IN FRANCE.

While in France will be found the best examples of what may be termed higher elementary schools, in which the children of artisans, small shopkeepers, etc., are afforded opportunities of obtaining an education which is technical in so far as their studies are specially directed towards the requirements of commerce, mechanical or manufacturing industries, and while in nearly all the modern French schools—of which that at Rheims may be taken as the best type—the laboratories for teaching practical chemistry, and the equipment of other special departments which teach the technology of the trades forming the staple industries of their respective districts, leave nothing to be desired, it is in Germany and Switzerland that the movement for industrial education has attained its highest development.

OBSERVATIONS OF THE BRITISH ROYAL COMMISSIONERS ON THE EFFECTS OF SCIENTIFIC TRAINING IN INDUSTRIAL ARTS IN GERMANY AND SWITZERLAND.

In the latter country the British Royal Commissioners found the value of its technical schools—the beneficial results of which were elsewhere more or less problematical—distinctly illustrated in the marked improvement of manufactures; in the elevation of the producing classes; in the diminution of crime; in the popularization of education, and, generally, exercising a most important influence upon the nation's industries and welfare. In summarizing the results of their investigations in Germany, they remark that the conviction is universal among the German people that they can only meet the competition of their rivals in other countries by training their workmen in taste and skill, and that the prosperity of their industries will increase only in proportion as they keep up the efficiency of their schools and spread their influence among the workers themselves. In support of this conclusion, extended inquiry shows that Germany and Switzerland, especially, are filling up with technological and polytechnic schools, many of them of a very high standard of instruction and usefulness. The polytechnic institute at Zurich [Exhibit B] may be cited as illustrative of this class of schools, which aim to combine theoretical and applied instruction in all branches of industry where scientific knowledge and skill in applying it are desirable. So successfully has this plan been

worked out at Zurich that students from all parts of the world seek admission to its institute; and, referring to it, the British Commissioners say they had opportunity of judging of the advantages which it has bestowed, not only upon Switzerland, but also upon Germany, by the number of thoroughly trained scientific men it has educated who are now holding important positions in various industrial establishments which they visited. A similar institution is that at Munich. [Exhibit C.]

DIRECT AND INDIRECT EFFECTS OF TECHNOLOGICAL SCHOOLS DESCRIBED.

The direct and indirect effects of technological schools upon the industries of their respective countries were, immediately upon their establishment, felt to be beneficial in the highest degree. Their graduates were eagerly sought out to fill important and responsible positions in manufacturing and commercial establishments, many of which had sustained serious losses through the ignorance and consequent bad management of administrative officers; and this inquiry soon far exceeded the supply. As the result of this appreciation of, and demand for, skilled laborers and supervisors, many enterprising corporations, and even private firms, engaged in manufacturing and other industries dependent for their successful operation and development upon intelligent direction and skilled labor, individually organized scientific schools and training classes in connection with their works. Some of these private schools excel most governmental and municipal institutions of similar character in enterprise, progressiveness and immediate practical results.

DEVELOPMENT OF TECHNOLOGICAL EDUCATION AMONG PRIVATE FIRMS AND CORPORATIONS.

The conductors of many of them claim that the best results are obtained where intimate relationship between the school and the actual workshop is maintained, thereby facilitating the adaptation of theoretical training to the needs of the pupils and the character of the work on which they are engaged. As illustrative of this method of combining practical and theoretical education, I cite the schools in successful operation at the mammoth works of Sir William Armstrong at Elswick; at the great works of the London and Northwestern Railway Company at Crewe (where more than 9000 men are employed and 600 apprentices and young journeymen attend the evening classes); and that at the works of Messrs. Mather & Platt, extensive iron manufacturers at Manchester. These are but examples of a large class of schools conducted in connection with manufacturing establishments which follow this system of education, and it is reported that a large additional number of corporations and firms, encouraged by the increased profits realized by those who have adopted it, are arranging to inaugurate similar instruction at their works.

TESTIMONY AS TO WHAT TECHNOLOGICAL EDUCATION HAS ACCOMPLISHED.

As the foregoing statements may contain somewhat startling propositions to those who have given the subject slight consideration only, it may be well to cite from authentic testimony as to what technical education *has* accomplished.

AT CREFELD, PRUSSIA, FOR ITS SILK INDUSTRY.

Crefeld, Prussia, a city of about 80,000 inhabitants, relies almost entirely upon the silk industry for its support, and its revenue therefrom amounts to more than £4,200,000 (over $20,000,000) annually. Its leading merchants and manufacturers unhesitatingly affirm that this great industry is very largely dependent for its success on the influence of their technical school, which is one of the best of its kind in all Europe. They declare that, among other benefits resulting from the school, it raises the tone and increases the knowledge of rising manufacturers and foremen, and by spreading technical education broadcast among industrious and ambitious artisans, very materially widens the field from which successful managers and specialists may be chosen.

AT MULHOUSE, GERMANY, FOR TEXTILE MANUFACTURES.

Mulhouse, Germany, affords another illustration of the fact that an industry may largely depend upon technical education. Its leading manufacturers claim that their textile museum, by its facilities for education, has exerted a most important and beneficial influence upon the leading industry of the district, some even going so far as to say that the trade could not in any degree prosper without the influence of this museum. Its principal citizens say that the town owes its great prosperity to the commercial and scientific knowledge principally acquired by its artisans in

technological institutions, and to the commendable public spirit and enterprise of its citizens in promoting general technical education among all classes; also that this action has exercised a marked influence in suppressing trade jealousies, which have almost entirely disappeared from this community.

AT VERVIERS, BELGIUM, IN MAINTAINING ITS PRE-EMINENCE IN CERTAIN MANUFACTURES.

Testimony to the same effect is given by employers at Verviers, Belgium. They claim that technical education is a great help to its industries. Their competition with other localities is very sharp, and the President of its Chamber of Commerce has publicly testified that their chief hope in maintaining pre-eminence as spinners and manufacturers rests on the superiority and not on the cheapness of their productions. This community has felt none of the evils of the late labor troubles in Belgium.

AT CHEMNITZ, SAXONY, FOR ITS TEXTILE MANUFACTURES.

Chemnitz, Saxony, is another city that freely acknowledges the benefits resulting from technical education. The British Royal Commissioners declare that to the Chemnitz weaving school should be credited the variety and excellence of the textile manufactures of the district. The zeal of the inhabitants of Chemnitz for technical education will be appreciated when it is stated that up to 1883 they had contributed over $440,000 for the support of their industrial schools. In their conversations with managers and foremen there, the Commissioners were informed that the importance of technical education was everywhere acknowledged in Saxony. One of its largest employers said that the influence of the schools upon the industries of Saxony, by increasing the intelligence and skill of the artisan class, could not be too highly estimated. [Exhibit D.]

EFFECTS OF TECHNICAL EDUCATION AT ROUBAIX, FRANCE.

In the city of Roubaix, France, considerable attention has been given to technical education. Mr. M. Carlos Delattre—a member of a commission appointed by the Mayor to investigate its effect on the industries of the town—said that during the ten years their technical weaving and dyeing school had been in operation, great progress had been made in the dyeing industry; that in every establishment where the sons of employers, foremen and workmen attended the classes, good results followed; that in the dye-works many of the young men can now make their own preparations; that there is *less need of supervision;* that *economy in production* has resulted from attendance at the school; and that *fewer mistakes* have been made, and *more reliable and efficient work* has resulted from its teachings.

TRAINING SCHOOL FOR MARINE ENGINEERS AT AMSTERDAM.

The training school for marine engineers at Amsterdam was established by private enterprise, in consequence of the great need for skilled engineers in its merchant navy. Owing to the ignorance and incompetence of the men who had charge of the machinery of their vessels, shipowners of Amsterdam suffered grievous losses, until they finally decided to found a school for training men to take proper care of their steamers. The originators of this school gladly testify to its economic value. (Second Report of Royal Com., Vol. I., p. 112.)

IMPROVEMENT IN FRENCH INDUSTRIES THROUGH TECHNICAL EDUCATION.

France has, of late years, been particularly active in making provisions for technical education. An important report on the wool industry of France states that so great have been the mechanical improvements during recent years that since 1867 the cost of wool-combing has fallen off 25 per cent.; that since 1851 the cost of spinning has decreased more than half, while during the same period the wages of spinners and piecers have increased 40 per cent. The report, after stating that the improvement in weaving has been still greater, says: "In 1851 the goods were irregular and imperfect, while as early as 1878 they had almost attained perfection, with half the manipulation and double the wages paid to the workmen."

EFFECTS OF EDUCATING COLLIERY FOREMEN AND ENGINEERS.

It is commonly acknowledged by the proprietors and managers of mines that young men who have been educated in technological schools heat their boilers better and with *less coal* than do the other workmen, and that their scientific knowledge enables them *to escape many accidents* and to avoid *stoppage of machinery*

and *repairs*. They are therefore very much sought after as firemen, and command higher wages than common firemen, because their services are more valuable to their employers. The Royal Commissioners mention the fact that several of the principal colliery firms of Europe have organized mining schools in connection with their works, and so convinced are the rest of the Continental colliery proprietors of the beneficial effects of this character of education that like schools are being generally established in the coal districts.

SUPERIORITY OF GERMANY IN ENGINEERING CONSTRUCTION DUE TO TECHNICAL KNOWLEDGE OF HER MECHANICS.

The generally recognized superiority of German artisans in the construction of roofs and bridges, both as to cost of construction, safety and durability, is to be attributed to the superior technical knowledge of her mechanics, which enables them to secure the necessary stability with the least consumption of materials and the minimum expenditure of labor.

DEPRESSION OF ENGLISH WOOLEN MANUFACTURES DUE TO SUPERIOR TECHNICAL EDUCATION OF RIVALS.

Comparing the worsted industries of France and England, the British Industrial Commissioners admit that France has far surpassed Great Britain in the manufacture of woolen goods. They say that while English depression in the woolen trade has been attributed to two causes—viz.: the greater cheapness of labor in competing countries, as represented by longer hours and lower wages, and the *superior technical education of their foreign rivals*—the cheapness of labor had very little to do with the depression, the real difference being found in the superior training and skill of the workmen of foreign nations, together with some minor local advantages on the side of the French manufacturers. They also say that since the establishment of a technical school at Bradford, equipped with various departments, qualified teachers, and the best obtainable apparatus and machinery for teaching designing, weaving and dyeing, the result has been that British all-wool goods of several varieties are taking their stand in English and foreign markets in open competition with those French and German goods which, but four years ago, seemed to enjoy almost a monopoly of public favor, and that, as a consequence, Bradford manufacturers are now operating as profitably as their rivals in any country. [Exhibit E.]

INFLUENCE OF TECHNICAL TRAINING UPON THE MANUFACTURES OF NOTTINGHAM AND BELFAST.

The manufacturers of Nottingham are unanimous and emphatic in their testimony as to the important influence of technical training upon their industries. They say that without this training some of their art-productions could scarcely have come into existence. The linen manufacturers of Belfast acknowledge that their ability to compete successfully with foreign nations in the more artistic productions depends on the higher training of their employes.

EFFECTS OF SCIENTIFIC AND TECHNICAL TRAINING ON CHEMICAL INDUSTRIES.

The beneficial results of high scientific and technical training on the chemical-color, beet-root sugar and alkali industries are especially noted by the Royal Commissioners. (See Rept., Vol. I, pp. 222–9.) They say that the beet-root sugar manufacture, which is a great source of wealth to Holland and yields large profits to firms engaged in that business, often dividends of 100 per cent, is a striking illustration of the rise and successful operation of a most important industry, depending upon the intelligent application of the scientific principles of engineering and chemistry.

SKILLED WORKMEN IMPROVE METHODS OF MANUFACTURE AND INCREASE PROFITS.

The firms and corporations of Europe that have been foremost in securing skilled workmen have been most successful in their enterprises. As a result of improved methods of manufacture and new discoveries made by their trained employes, large profits are often realized by such employers.

TECHNICAL SCHOOLS PROMOTE SCIENTIFIC INVESTIGATION AND METHODS.

In short, it is the testimony of all who have studied the subject that technical schools, when rightly directed, give wonderful impulses to industrial pursuits by promoting scientific investigation and methods. Athough at first this influence affects only those who attend the classes, it soon makes itself felt throughout the

entire body of workmen of the community to which the school belongs, and the increased interest in scientific subjects on the part of employes, thus developed, in turn reacts to the pecuniary advantage of their employers; because mechanics who have been trained in the scientific principles that underlie their handicrafts are thereby enabled to understand the technical publications affecting their trades, and to utilize new inventions and improved methods of work; while men uneducated in the rudiments of science ignore such sources of knowledge and, quite naturally, oppose all improvements as innovations calculated to work injury to the laboring classes. Cultivate a laboring man's intelligence to a point where it recognizes improvements and comprehends their nature; his opposition ceases, and he will himself likely invent improved processes, which will inure to his employer's benefit.

THE DECADENCE OF THE SILK INDUSTRY IN LYONS DUE TO RETENTION OF THE OLD-FASHIONED METHODS OF MANUFACTURE.

The truth of this is exemplified in the history of the rival silk industries of Lyons and Switzerland. The skill of the weavers of Lyons in the use of hand-looms was marvelous, but they combined no intelligence with it, for they had no scientific training. They clung tenaciously to those looms—relics of their ancestors—long after the introduction elsewhere of power-looms, and thereby almost wrecked the silk industry of Lyons. A leading merchant of that city, in speaking of this fact, recently said: "They have all, however, both masters and men, fallen behind the times in enterprise, clinging to traditions and old-fashioned methods, while their competitors have been organizing factories and teaching their workpeople the use of the power-loom, and other economic inventions. During the last ten years Lyons has, consequently, lost very much of its trade." Their enterprising Swiss competitors, on the other hand, engaged highly trained teachers, who brought to bear upon their work the scientific principles taught in the polytechnic schools rom which they graduated, and introduced the inventions of which they there cquired knowledge. As a consequence the cantons now surpass Lyons in many inds of weaving and in dyeing, as they do other trade centres in various industries.

TECHNICAL EDUCATION ATTRACTS CAPITAL.

Technical education has been the means of attracting capital not only to specific localities, but to countries. Indisputable evidence of this is found in Switzerland, and notably in Zurich, the manufacturing town above cited. For years a technical school has been conducted in this town at government expense, and when recently the Federal Council was disposed to lessen the usual grant for its support, the manufacturers showed, by undeniable evidence, that this single institution had in a few years been the means of bringing capital to the country to the extent of millions of pounds sterling.

THE BRITISH ROYAL COMMISSIONERS TESTIFY TO THE EFFECTS OF SCIENTIFIC KNOWLEDGE AND ITS GENERAL APPLICATION TO SPECIAL INDUSTRIES.

Other and even more forcible illustrations of like character might be cited *ad infinitum*, and can be furnished, if desirable, but they are substantially covered by the British Royal Commissioners, who, in summing up the results of their study of the effects of technical education on the continent of Europe [Exhibit F], say that they cannot repeat too often how strongly they have been impressed with the general intelligence and technical knowledge of the masters, managers and workmen of Continental industrial establishments They have found that both classes, as a rule, possess sound and liberal knowledge of the sciences and principles upon which their industries depend; that they are familiar with every new scientific discovery and invention of importance, and can and do apply them to the development of their special industries, adopting not only the improvements and inventions of their own countries, but also those of the world at large.

TECHNICAL EDUCATION HAS PASSED ITS EXPERIMENTAL STAGE IN ENGLAND.

They further testify that a few years ago the question of technical education in England would have been a debatable one, but that now no argument is needed to convince English employers of its importance; that it has been tried and has given the highest satisfaction; that in nearly all the great industrial centres—in the metropolis, in Glasgow, in Manchester, Liverpool, Leeds, Bradford, Sheffield, Nottingham, Birmingham, The Potteries, and elsewhere—more or less flourishing schools of science and art, of various grades, together with numerous art and science

classes, are to be found in successful operation, and that their influence may be traced in the improved productions of the localities in which they are placed; in the decreased consumption of crude material, and in saving of time required for the performance of labor.

In short, one cannot study the present condition of European nations without being thoroughly convinced of the great economic value of scientific training to their industries, morals, and all that tends to shape the affairs of the world to their advantage and to the happiness and prosperity of their people.

TESTIMONY OF PROFESSOR HUXLEY ON THE ECONOMIC VALUE OF SCIENTIFIC KNOWLEDGE.

Further testimony on the economic value of scientific knowledge in connection with the staple industries is furnished by the well-known Professor Huxley, who, answering the question, "What bearing do you consider that superior general culture in Germany has upon the industries of Germany?" said:

> The bearing of it, if I do not misapprehend the matter, is this: The development of industry under its present conditions is almost entirely the effect either of the application of science, or of the development of mechanical processes of complexity, requiring a great deal of attention and intelligence to carry them out; and I do not think that I am wrong in supposing that the advance of industry in all countries depends on employers being able to find to their hand persons of sufficient knowledge and sufficient flexibility of mind to be able to turn from doing the thing they have been doing and to do something different, according to the nature of the improvement that has been made. It is there, I apprehend, that the advantage of such scientific training as can be got in those small universities of Germany is manifested. Scientific training is of infinitely greater importance in the case of such a man than literary training, because no amount of literary training ever enables a man to understand what it is to deal with facts at first hand; it does not conduce to that habit of mind which is most useful to a man in the practical affairs of life. Scientific training does conduce to it, though it may not produce it.

TESTIMONY OF PROFESSOR VON HELMHOLTZ.

Professor von Helmholtz also points out not only the general advantages, but the absolute necessity, of employing, as heads of departments, persons conversant with the theory of their work, and able, by virtue of their scientific knowledge, to anticipate results, and to calculate beforehand the quantity and quality of material required, as compared with those who, lacking such attainments, are compelled to adopt—often at greatly increased cost—the more empirical methods of repeated trial.

AGENCY OF TECHNICAL SCHOOLS IN SUPPLYING TRAINED SPECIALISTS AND DEVELOPING INDUSTRIAL ARTS.

In short, it is almost universally testified by the observant that technical schools have supplied a long-felt want for trained specialists, who have been, and constantly are, the source of unexpected economies; not alone because, through their scientific knowledge, superior training and habits of thought and observation, they are able to anticipate results, and to give intelligent direction to their subordinates—inspiring them with interest, and often enthusiasm, in the discharge of their duties—but also because, through the utilization of the latest discoveries of science, they improve methods of production, turning out superior articles with marked economy. Through the agency of such schools originality has taken the place of servile imitation; decaying industries have been revived, and new ones promoted; while they have exerted a most marked influence in developing the intelligence and skill, and consequently in securing the permanent prosperity, of the industrial classes generally—the people by whom the work of the world is done, and upon whom national, no less than corporate and individual, wealth depends—by enabling them to develop the sources of wealth peculiar to each country.

SCIENTIFIC KNOWLEDGE PROMOTES THE WELFARE OF EMPLOYES AS WELL AS OF EMPLOYERS.

Ability on the part of laborers to understand something of the principles that underlie their various handicrafts is productive of good results, not only through lessening the cost of production, but also in advancing the welfare of the employes themselves, by enabling employers to pay better wages for articles of superior workmanship and manufacture, from which they derive greater profits.

EDUCATION PROMOTES INDUSTRY AND THRIFT.

During its last session, the British Parliament was compelled to take into "*serious consideration*" the condition of the overcrowded districts of London and other large industrial centres, and the debates in the House of Commons developed an almost

unanimous opinion that only through government furnishing, in some form or other, additional facilities for industrial education lies the temporal salvation of their idle population—semi-paupers through lack of knowledge of how to work. While our own General Government is not parental, in the sense that European Governments are, our State and municipal governments do, in theory, very nearly approach that relationship, and can exercise their functions in no more beneficial way than by fostering the *industrial* education of their people.

In his report for 1868, the French Minister of Public Instruction gave testimony as to the valuable results of technical training as follows:

> Science continues its discoveries, and every day places at the disposal of industry new and serviceable agents; but in order to be applied, those agents, which are sometimes very delicate and sometimes very powerful, require to be skillfully handled. This is the reason why, in the present day, industrial progress is so intimately connected with educational progress, and why questions which it is the duty of the University to examine and to solve have acquired so great an importance as regards the material prosperity of a nation.

A most noteworthy example of the truthfulness of this statement is found in Switzerland—a country beautified by Nature with lakes and mountains and a climate that has made it the beloved of artists and poets, but denied ports, navigable rivers, canals, mines, fertility, or those other *natural* gifts which are the usual foundation of the prosperity of other civilized States. Yet from among those sterile rocks there are yearly exported industrial products not only in excess in value of all the importations of the cantons (including the two hundred and odd millions of francs' worth of goods which they purchased from France alone), but more than sufficient also to cover the cost of internal administration. Industrial education alone can claim the credit of elevating this nation—which in former times cultivated mercenary warfare as its sole occupation—to the first rank in those manufacturing industries requiring individual skill and intelligence.

I cannot more forcibly close this section of my report than by the following quotation from the work of the eminent scientist, engineer, builder and educator of Great Britain, J. Scott Russell, on SYSTEMATIC TECHNICAL EDUCATION FOR THE ENGLISH PEOPLE, 1869:

> I may add that in every country where technical education has taken root and had time to bear fruit, I also find unquestionable proofs of the rapidity with which increased intelligence and enlarged knowledge bring increase in employment and remuneration. From my personal experience, I may say that within the last twenty-five years I have seen large branches of commercial trade leave one country and plant themselves in another, because the workers of the one were educated and those of the other uneducated. And I have watched nations rising into importance and power by education and by the order, organization and efficiency which education bestows; and other nations lagging behind and losing their place by reason of their unwillingness to educate either the higher or lower classes of their people. (P. 76.)

DEVELOPMENT OF INDUSTRIAL EDUCATION IN THE UNITED STATES.

If the results of an educational system can be ascertained from a close inspection of those industries in which the mass of a country's population is engaged, and in which their knowledge is displayed by the fruits of their labor, it will be found that the national system of popular education in the United States fails entirely in accomplishing its mission, in several important particulars.

PUBLIC SCHOOLS IN AMERICA FAIL TO PREPARE FOR INDUSTRIAL PURSUITS.

For example, in the public schools our youth are, as a rule, entirely untaught in even the rudiments of industrial occupations, and upon passing from the schoolroom are generally utterly incompetent, unassisted, to earn a livelihood in any trade or pursuit requiring manual dexterity. Even our high schools leave their graduates to drift, by accident or unintelligent direction, into avocations generally foreign to their abilities, and, as a rule, with few exceptions, unequipped with that character of knowledge or expertness without which a comfortable living becomes difficult—prominence impossible. It is commonly accepted as fact that a good elementary education such as is afforded by our public-school system gives a child that which will carry it well along in life; but this is true only of agricultural, or at most of sparsely settled districts, and is then true only within limitations.

SCHOOL TRAINING SHOULD BE SUPPLEMENTED BY TECHNICAL KNOWLEDGE.

In the crowded countries of Europe, and in our own Eastern and Middle States—wherein labor and industrial problems already closely approximate those in Europe—there is an increasing recognition of the fact that, though good school tuition is always important, to be effective it must be supplemented by such technical knowledge and training as will enable the student to survive in the battle for existence—which is deadliest in those sections where dense populations cause the sharpest and most active competition.

PUBLIC SCHOOLS TURN OUT CONSUMERS, NOT PRODUCERS.

In other words, the tendency of our public schools is—by elevating pupils above their actual or probable stations in life, and prompting in them desires and aspirations of which there is little chance of fruition—to turn out a large class of consumers, who fail utterly of success in the professions and kindred occupations, under conditions which, had their efforts been directed to mechanical or other industrial pursuits, would have made them efficient producers. Most of the education acquired under our common-school system is temporary and only preparatory for such higher studies as do result in business qualifications; whereas, to be of immediate benefit to the masses, school education should of itself give the graduate an earning capacity. Says Judge MacArthur, in a recent and interesting treatise on popular education: "To graduate one taught to think only, is like sending a ship to sea in charge of a navigator, without a single person on board who can understand or execute his commands."

POPULAR EDUCATION SHOULD INCLUDE THE CULTIVATION OF PHYSICAL DEXTERITY.

Knowledge and mental discipline alone do not constitute all of education. To be practical and useful to most of those who must earn their own livelihood, education must also afford physical dexterity, with special reference to the industrial pursuits of life. As the result of this absence of instruction of a practical character, a remarkably small percentage of our public-school graduates in the Middle and in the Southern States engage in any kind of manual labor.

HIGHER EDUCATIONAL INSTITUTIONS SHOULD COMBINE INDUSTRIAL AND SCIENTIFIC INSTRUCTION.

Recognition of this lack of *utility* in our educational system has, of late years, become quite general, resulting in variously directed efforts to engraft upon our higher-grade institutions industrial and scientific instruction, and the colleges and schools whose curricula embrace those subjects which fit our boys and girls to participate in the practical work of life are now rapidly increasing. There have long existed in the United States a certain number of educational institutions wherein special attention is given to technical and scientific training in mining, civil and mechanical engineering, applied mathematics, physics and the natural sciences, which are fully equal to the best of similar schools in Europe.

COLLEGES WHICH AFFORD ADVANCED SCIENTIFIC INSTRUCTION.

Among the most prominent of these are the School of Agriculture and Mechanical Arts of Cornell University, the School of Mines of Columbia College (N. Y.), the Massachusetts Institute of Technology, the Lawrence School of Science in connection with the Harvard University, the Pardee Schools, the Stevens Institute at Hoboken, the Rensselaer Polytechnic Institute, and the Sheffield School at Yale; but the high tuition fees charged by these and similar schools make instruction therein available only for the wealthier classes.

ELEMENTARY SCIENCE — HOW TAUGHT IN OUR COLLEGES, ACADEMIES, AND HIGH SCHOOLS.

In addition to those institutions which afford special facilities for advanced instruction and original research in science and the mechanic arts, in most of the States elementary science is now taught in numerous colleges, academies, and high schools. While this instruction, in point of cost and preliminary educational qualifications, is generally within the reach of the masses, the subjects taught and, as a rule, the manner of teaching them have but little practical bearing on industrial pursuits. However, in the last few years considerable progress has been made in introducing a substantial help to industrial education—that of manual training schools—and already their feasibility and desirability as a feature of popular education have been practically demonstrated Well equipped schools of this character are to be found in St. Louis, Chicago, Toledo, Philadelphia, and Boston.

POPULARITY OF MANUAL TRAINING SCHOOLS.

The secret of the popularity of this kind of education is to be found in the *natural* and *practical* combination it makes of *intellectual* and *manual* training. Both thought and action are developed equally, and the skill acquired at school, together with the respect for industrial pursuits there fostered, makes their pupils useful, wealth-producing citizens.

SUCCESS DEPENDENT UPON A THOROUGH UNDERSTANDING OF OBJECTS FOR WHICH THE SCHOOL IS INSTITUTED.

The success of the manual-training schools at Chicago and St. Louis, and most other points where inaugurated, has far exceeded the sanguine expectations of their originators. That our own Baltimore school, as appears by the dissensions in its management, to which so much publicity has recently been given, has not been equally successful simply proves that the objects for which it was instituted, and the methods by which practical technical education is to be accomplished, have not been understood by those controlling its policy and operations.

COMBINATION OF MENTAL AND MANUAL TRAINING NOT VISIONARY.

The results that have already been achieved elsewhere by kindred schools prove that efforts to combine mental and manual training are not visionary, while the liberal patronage which such schools, properly conducted, have uniformly received is abundant evidence of the demand that exists for the training they afford. But these schools can each provide for only two or three hundred boys at most, while there are thousands more—equally anxious to receive the same kind of instruction and equally meritorious—who are denied, through lack of facilities, their equal rights to public mechanical instruction.

A few years ago the United States Commissioner of Education requested a number of large and experienced employers of labor, and others qualified to form reliable opinions on the subject, to express their views upon the comparative value of educated and uneducated labor in America. Answers were received from many men whose acknowledged ability and experience entitle them to consideration as authorities upon the subject of this report, and I therefore invite your thoughtful perusal of the few selected answers printed in Exhibit P. The evidence thus accumulated by Commissioner Eaton shows a very general concurrence on the part of our farsighted employers in the foreign testimony above outlined; but there seems to be far less appreciation in the minds of our statesmen and educators of the fact that, by making public-school instruction—which has by elevating the general intelligence measurably increased the productiveness and efficiency of labor—preparatory to special technical training, they will not only directly promote the nation's industries, but also make general education far more popular with the masses.

REPORT OF MR. WM. MATHER, OF ENGLAND, ON TECHNICAL EDUCATION IN THE UNITED STATES.

Pursuant to the idea of avoiding *ex parte* evidence in this report, in further analyzing the state of technical education in the United States, I am fortunately able to avail of the labors of Mr. William Mather, who, as the representative of the British Royal Commissioners charged with an examination into industrial and technical education in America, patiently and exhaustively investigated, not long ago, the educational and industrial institutions of the United States. Mr. Mather is an accomplished expert in technical education, and from no higher source could disinterested and unprejudiced testimony on the subject be obtained. Extracts from his report are given as appendices, and a few of his observations upon our educational system, peculiarly pertinent, are here quoted.

Says Mr. Mather:

> It is much to be deplored that in the majority of institutions in America where science is taught in the abstract there are no departments arranged for such technical training as exists in some I have described.
>
> The demands made upon those which give technical instruction are greater than they can satisfy. This accounts for the high fees charged, and also for the fact that the advantages of such technical schools are in the main confined to the sons of wealthy manufacturers or professional men.
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> All these evidences of scientific skill (American mechanical contrivances) speak well for the methods of education in the recent past, so far as it goes; but other influences, such as "necessity the mother of invention," and the presence in America of foreign experts, will account for much of the rapid growth in the mechanic arts.
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> It is, of course, in the more recent structures and modern mechanical appliances that the evidence of scientific truths and methods is observable. The rough-and-ready contrivances of early railroad development indicate originality and "mother wit"; but in the waste of material and crudeness of design may be noticed the absence of technical or scientific training on the part of those who conducted extensive engineering or mechanical operations in those days. The gradual diffusion of science is very marked in the rapid reconstruction, during recent years, of the great railroads of the past, and in the new main lines. Also, in railway plant generally the old is being replaced by the new, and the latter exhibits high theoretical knowledge combined with practical ingenuity.

The Americans undoubtedly owe to European engineers the rapid advance they have been able to make in their public works. The conservation of water power for the use of the mills at Lowell and Lawrence, in Massachusetts, is due to the eminent hydraulic engineer, Mr. Frances, an Englishman, who practised for 40 years in America. The water rights of a district are held in trust for the whole community by a board or corporation elected for the purpose. The power is distributed according to the share which may be purchased or rented by the users, but regard is had to the rights of all, and its utilization requires great skill and knowledge to prevent loss of power. Mr. Frances has had charge of this important work for many years, and is deservedly esteemed as the highest authority on hydraulic engineering in America. Although a lucrative field was, in the early days, open to European engineers and machinists having a thorough scientific knowledge of their profession, yet it is evident that they found apt scholars, who, as they acquired some theoretical science, launched out into new paths untrammeled by the traditions of the older countries.

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It would appear that employers and foremen no longer value the labor of boys under 17 years old in machine shops. There is, in fact, a marked discouragement shown by managers of most of the works I have visited to the employment of boys. The assistant manager of the Edgar Thompson Steel Works "thinks boys under 18 years old ought to be at school." He was educated at the School of Mines, Columbia College. The whole tendency is to engage boys as they do men, only for what they are worth. The evil of this will be severely felt in the future, if not mitigated by great changes in education, for the reason that many boys are obliged to leave school at 14 or 15, and if they are not allowed to enter the skilled trades they will be thrown upon casual employments or unskilled pursuits for temporary gain and a livelihood. Thus a mass of incompetent and unskilled laborers would grow up incapable of going out West, and would become a drug upon the labor market of the East. It is undoubtedly a shortsighted policy on the part of employers to discourage the employment of boys, without aiding those movements which, in the form of industrial schools, would enable a boy to qualify for service at 17 years old at a higher rate of wages than he could probably get at that age but for this training.

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The future development of American industries will depend upon a population not compelled to dare and endure and experimentalize for "very life." In the past the waste of material has been excessive. To make the best use of a given quantity of material requires a sound knowledge of its properties and of its disposal in the arts and manufactures by scientific methods. In this direction the technical and science schools already instituted have accomplished much in providing foremen and managers, chemists, miners, and intelligent employers in the engineering and manufacturing industries. Some extensions of these institutions are now being promoted. One significant indication of progress in this direction was afforded me during my travels. I attended a convention of about a thousand teachers, professors, and principals of schools and colleges, at Saratoga, and another similar gathering in the White Mountains. The discussion of technical and industrial training was the chief feature of the conventions. I was much impressed by the high qualities of culture and character which distinguished this truly "Grand Army of the Republic" in its 300,000 teachers, as represented at these meetings. If this force should be directed by a change of tactics, so to speak, in the schools, to scientific and technical instruction, and to less concentration upon purely literary subjects, there can be no doubt that America will solve the industrial-education question more rapidly than any other country, and utilize it in the further development of her inexhaustible resources.

It must not be supposed that Nature has bestowed her gifts over this continent in such wise that they can be enjoyed without much skill and labor in the gathering of them. No country offers more difficult problems to the engineer, the agriculturist, and the manufacturer. A climate of extremes; a scarcity of water in the West; the difficulties of cheap transport and distribution, all require the highest qualities of self-reliance and endurance, with scientific knowledge, in the progress of the future.

It is remarkable that, in the great centres of the mining and iron-producing districts, where also a large amount of mechanical construction is carried on, as, for instance, in Pittsburgh, Chicago, Detroit, Cleveland, and Philadelphia, so little has been done by the owners of large establishments, or by the town or State authorities, in the direction of technical schools or evening science schools. These industries represent a large proportion of the working population in those large cities, and yet the owners of works have to rely upon the scientific knowledge obtained through many institutions remote from these districts. Pittsburgh is lamentably devoid of facilities, either in the shape of libraries, museums, science schools, or technical schools, notwithstanding that the manufacturers have enjoyed the benefits of, and accumulated vast wealth from, highly protected industry. There is not even a public library in the city, although there is a population of about 200,000.

In Cleveland a movement is being promoted to establish a technical school. I have already stated that Chicago is building a manual-training school.

It is a noteworthy fact, that, among all the many munificent gifts which have been made by private individuals for the cause of education, amounting in the aggregate to many millions sterling, very few have emanated from those who have derived their wealth from the scientific industries, all of which have been protected and owe much of their success to foreign skill. On the other hand, merchants, bankers, and professional men are largely represented in the noble list of benefactors connected with some of the best educational institutions of the country.

I have not met with any institutions for technical training having any bearing on the textile industries. The knowledge of chemistry acquired at the various institutions which I have described is, of course, utilized more or less in dyeing, printing, and bleaching; but there are no schools in which the knowledge of the nature and qualities of fibres, and of the various processes in working up the raw material—silk, cotton, or flax—is taught. In all the manufactures into which taste and design enter, the Americans have to rely almost entirely upon European aid. It is intended, however, so I am privately informed, to establish, in one of the centres of textile industry, a large institution in which a thorough and comprehensive industrial training will be given in textile manufacturing, together with that theoretical knowledge which is necessary to the production of the highest quality of fabrics.

I have not included the Southern States in my investigations by a personal visit to the various important towns, for the reason that education, for the present, is at a low ebb in that part of the country. There is, however, a very strong movement already apparent for the promotion of mechanical and textile industries in the South. The enormous resources of some of the States—Alabama, for instance—where mineral wealth abounds, have attracted capital for the rapid development of various manufactures. This, together with the proximity of the cotton-growing districts, points to a development, in the near future, of many industries which, until recently, were unknown in the South. * * * The different colleges established by the assistance of the "Land Grant" appear to have done good work, in connection with agriculture, in the South, in teaching the elements of science and in providing a liberal education for those students whose means have enabled them to attend. The mechanical arts have had less attention in such colleges than in similar institutions in the North, in consequence of the difference in the occupations of the people.

The institutions for the advancement of the workpeople, other than schools and colleges, are not numerous in America. The long hours of labor (at least 60 hours a week) leave but little leisure for the working classes either to study or to seek recreation. There is no half holiday on the Saturday. There are no holidays during the year of more than one day at a time, and that only a few times in the year. Libraries and reading rooms, although amply provided in most cities and towns, are not available as universally as in England. Clubs and recreative institutions, promoted by the employers for the employed, are not prevalent. There is not much interest manifested by employers generally in the social condition of the people. This may be accounted for by the number of joint-stock companies.

If the few institutions affording technical education now in operation in the United States have been able, in a short time, to accomplish so much in those branches of mechanical industry in which Americans are confessedly pre-eminent, as is shown in the testimony from which extracts are appended to this report; if, through our inventive and mechanical ingenuity we are, as Mr. Mather and other intelligent foreigners say, taking high rank in those arts and manufactures to which fertility of resource and invention is most effectively applied—and that, too, notwithstanding our totally inadequate provision for industrial education—with what hope might we not look forward to equal or greater pre-eminence in other arts and industries of which their technical schools have given foreign countries a practical and profitable monopoly?

OUR NATIONAL PROSPERITY NOT DUE TO SUPERIOR TECHNICAL TRAINING, BUT TO OTHER CAUSES.

That our national prosperity has been greatly promoted by the pre-eminence of certain of our manufactures in the markets of the world is undeniable, but that this successful competition has been due not to the *superior* intellectual cultivation, or even the *manual skill, of our native artisans*, but to very different causes—such as abundance and quality of crude material; superior facilities for economical manufacture; the aid of imported skill, and those natural and untaught qualities to which Mr. Mathers and others pay such high tribute—is likewise easily demonstrable; and it is sad to reflect what greater success might have been achieved by combining therewith that high degree of intelligence and skill that European nations, under the compulsion of competition, are sedulously cultivating in their industrial classes. We must soon place greater dependence upon the quality, finish and unique designs of our exported products for success in unprotected foreign fields, and it will be well for us to profit *now* by the experience of our rivals across the Atlantic. It is wiser and cheaper to discount defeat than to repair its effects. The season of prosperity is the best time to provide against the depression which, with certainty, follows; and the knowledge and skill of the specialist are most efficiently and economically applied to an industry in its infancy or when it is in a depressed condition.

ACHIEVEMENTS OF INDUSTRIAL SCHOOLS IN EUROPE SHOW WHAT MIGHT BE ACCOMPLISHED BY SIMILAR SCHOOLS IN THE UNITED STATES.

From the foregoing it will be noted that the careful, thorough and extensive investigations of the English Government, supplemented by the published observations of individual students of recognized ability and accuracy, have resulted in the uniform testimony that polytechnic and other science schools in Europe and the United States have, without exception, stimulated national and local industries, manufactures and trades, and, in a large proportion of instances, have transplanted or developed new industries. Even the few—and not selected—illustrations of this fact which the compass of this report permits to be made therein, bear forcible testimony to the achievements of such schools [Exhibits F, O, and Q], and are suggestive of the profit which our more populous districts—and especially those seaboard cities which, as the termini of our great trunk lines, become the focus for many manufacturing, mechanical and other interests dependent upon the products which they transport—might derive from the investment of a reasonable amount of corporate and individual wealth in the establishment of similar schools, adapted, of course, to the wants of our peculiar industries and institutions.

WORKSHOPS DO NOT COMBINE MENTAL AND MANUAL TRAINING, AND OUR PRESENT SCIENCE TEACHING IS OF TOO HIGH A GRADE.

While it may be said, with some show of truth, that the most practical technical schools are great workshops, still the ordinary workshop does not *yet* combine mental instruction with manual training, while our science teaching is of too high a grade to be assimilable by the ordinary mechanic and mechanical apprentice, and is too theoretical to be adaptable to the current work of our shops. Not only is there too little *application* of science to our various handicrafts, but there is, for the most part, a sad lack of intelligent effort to teach apprentices *in* our workshops that manual dexterity which, at least, they are supposed therein to acquire.

SOMETHING NEEDED TO TAKE THE PLACE OF THE OLD SYSTEM OF APPRENTICESHIP.

Now that the old system of apprenticeship is rapidly becoming obsolete, the question of what shall take its place in the way of educating and training the youth of our working classes becomes an important consideration for all who are interested in our national welfare and in the development of our industries. Skilled labor must be had from some source, and we cannot afford to import it in bulk, if for no other reason than its expensiveness.

HOW TO MAKE OUR LABORERS THE EQUALS OF FOREIGN WORKMEN.

Our own people have the first claim upon our industrial occupations, but if we are to compete for foreign trade they must be so trained as to make and keep them, in knowledge and skill, at least the equals of foreign workmen. The most practical way of affording them this training is to build up special low-grade science schools, where the instruction shall be of such a character as will directly bear upon our arts and manufactures; for if any lesson can be drawn from the study of technical education abroad, it is that progress and success are most readily and cheaply attained by means of combined theoretical and practical instruction, and that our designers, our superintendents and our foremen, *at least*, should be scientifically and practically trained experts. [Exhibit G.]

Without dwelling further upon this point, however, the foregoing statement and the several exhibits hereto appended sufficiently demonstrate how much the United States already owe to those schools wherein the application of science to the mechanic and useful arts is *practically* taught [Exhibit Q]; as also that, as a people, we have been singularly backward in discovering how potential a factor in internal politics and in our domestic and foreign trade relations the systematic cultivation of our laboring classes in technological knowledge could be made.

THE MISSING LINK IN OUR EDUCATIONAL SYSTEM.

It is obvious that to supply the missing link in our system of national education there must be either a modification of the curriculum of our public schools, as suggested by Mr. Mather, or we must establish schools intermediate between our grammar schools on the one hand and our high schools, academies and colleges on the other; which, while affording our youth those opportunities and facilities for technical instruction that are absolutely necessary to the devolopment and success of many languishing industrial and manufacturing interests, will also fit them for the higher duties of American citizenship.

COST AND CHARACTER OF NATIONAL EDUCATION.

In 1880 the United States contained 189,000 elementary schools, having 9,720,000 pupils. Our national and State expenditures for the support of public schools now largely exceed $100,000,000 per annum, and the value of our school property is not less than $200,000,000. These expenditures exceed those of England and Wales nearly five times, and those of France nearly four times. In the number of pupils and the expenditure of money on our public schools we lead the world, and yet neither our State nor national appropriations in aid of *industrial* education for the working classes have been sufficient to make more than an impression upon the great mass of technically uneducated labor of the country. [Exhibit L.]

Says Judge MacArthur, in his excellent work on Education in its Relation to Industry:

To compete successfully with foreign work we must have a class of artisans as highly cultivated in workmanship as those we import from over the sea, and this skill can be acquired only by practice in their respective handicrafts. It is true that with us applied science and mechanical powers have superseded, in a great measure, the burden of heavy labor; but the quick eye, the expert hand and the acute taste can never be dispensed with in the manual processes of the arts and manufactures. To meet this imperative demand for first-class workmen, without submitting to the exactions and competition of foreign work, we must educate the constructive ability of our youth during the period of life which is now devoted to study alone. We have developed, in a high degree, the arts of manufacture, but we are nearly without any American artisans in the trades connected with designs, and are consequently deprived of the acknowledged sharpness and ingenuity of our countrymen in helping on American industries. This wide and remunerative field of labor is left to be occupied by partly educated and skilled foreigners. We have excellent schools for all sorts of instruction in the essentials of mathematics, history, literature and philosophy, but we fit nobody with either skill or knowledge in any particular habit of industry.

The period seems to have arrived when institutions of industrial science and education can no longer be postponed in our country, and when they must be tried on as extensive a scale as those witnessed abroad. There seems no reason why the institutional system should not be adapted to the tradesman, the artisan and the manufacturer, as well as to the more pedantic professions, in which

men are so thoroughly trained. The reform of our taste has commenced by the purifying influence which proceeds from, and which will gradually make its way through, the community from the universal teaching of drawing. An appeal must now be made in behalf of teaching the processes of production, as well as the principles which shall guide the work. The use of tools and machinery does not come by intuition, and industrial knowledge ought to include instruction in their use.

ABSENCE IN OUR COUNTRY OF INSTITUTIONS FOR COMBINED GENERAL AND MECHANICAL EDUCATION.

With a very few exceptions there is, in our country, a conspicuous absence of institutions for combined general and mechanical education of the character which, in France, Germany and in other Continental nationalties, are regarded as the great source of national wealth, and which are beginning to play a most important part in the promotion of those trades and manufactures with which England is coming to the front.

ACT OF CONGRESS, JULY 2, 1862, PROVIDING FOR INDUSTRIAL EDUCATION.

Though Congress, by its act, approved July 2, 1862, setting aside a large portion of the territorial wealth of the nation for industrial education, inaugurated a sagacious scheme for "teaching the processes of production," and their underlying principles, which, wisely and energetically followed up, would in a short time have placed the United States in the foremost rank of civilized nations in the theoretical knowledge and skilled training of its work-people, and have developed many old and created new industries, thereby more rapidly enriching the country, most of the provision made by that act for industrial and scientific teaching of the masses has, by reason of the paramount importance attached to agriculture in most sections, been absorbed in the endowment of agricultural colleges—so called.

COURSE OF STUDY IN AGRICULTURAL COLLEGES NOT WHAT THE AUTHORS OF THE ACT INTENDED.

Whilst these colleges, as first contemplated, were to have departments for teaching mechanic trades, most of them have drifted away altogether from the original intention of the authors of the act, and there is in them, generally, little or no effort to combine theoretical instruction with practical mechanical training in other than those branches of knowledge closely related to agricultural pursuits. Much remains to be done before they can be of any material advantage to manufacturers and others requiring skilled labor. If their managers are to fulfil the design of Congress, they must, much more than at present, turn their attention to the training of experts in mechanical and industrial arts; for it is only in schools devoted to instruction of this character that the poor youth of our country can obtain such instruction and training as will enable them to acquire and maintain that supremacy over foreign rivals in important arts and manufactures to which our many advantages entitle us.

MECHANICAL AS WELL AS AGRICULTURAL COLLEGES ARE NEEDED.

It is true that agricultural colleges have, *per se*, a great mission to fulfil, especially in our Western and Southern sections; but as Congress, by express terms, provided and intended its appropriation of school lands to inure to the advantage of all industries equally, and as many important interests of the country require that technological instruction should be placed above mere dependence upon individual support, the remodeling of those colleges is necessary to bring them into harmony with national legislation, and such action would probably stimulate State and municipal authorities to effectively supplement national appropriations.

OUR BEST SCHOOLS ARE THOSE SUSTAINED BY ENDOWMENT OF PRIVATE INDIVIDUALS.

At present our most efficient institutions for affording technical education are those established and sustained, wholly or in part, by the endowments of private individuals. It is not to be inferred, however, that this assertion implies that Government and State schools *might not* be made equally—and even more—efficient than similar private institutions. But it happens that, as a rule, endowments have been left under conditions and instructions more specific than in the case of Government and State grants, and have therefore been less easily diverted from their legitimate objects, and are, besides, less susceptible to those influences which with us almost uniformly prostitute public educational funds to political or sectional purposes.

DESIRABILITY OF DONORS EXECUTING THEIR OWN BENEFACTIONS.

Still it is a stern fact that should be recognized by all would-be founders of educational institutions, that this character of *trust*, especially, affords much opportunity for misapplication, even under the most carefully guarded legal phraseology, and that the most conscientious trustees and managers are not proof against the temptation of construing, and even forcing the construction of ambiguous terms, in harmony with their individual predilections. Moral:—Execute your own benefactions.

In just what manner private appropriations and city systems of public instruction should deal with industrial education is a grave problem, but the labors of the Bureau of Education at Washington have resulted in the collation of a mass of data, not only upon the needs of the country in this regard, but also in reference to the many experiments and efforts (mostly successful) to inaugurate technical education in various localities, that will greatly aid in its solution. Among other of this Bureau's reports, Circular of Information No. 1, 1885, containing the observations and views of John D. Philbrick, LL. D., State Superintendent of Public Instruction in Connecticut, and, later, Superintendent of Boston Schools, upon the city-school systems in the United States, is of special value and interest to boards of education, school superintendents and educators generally. Extracts from those pages of his report devoted to the consideration of industrial education, and the necessity for it in the United States, are appended hereto, and their careful perusal is earnestly recommended. [Exhibit N.]

CONCLUSIONS OF DR. PHILBRICK UPON THE SUBJECT OF INDUSTRIAL EDUCATION IN THE UNITED STATES.

Summing up his conclusions as to what should be done for industrial education by city systems of public instruction, Dr. Philbrick says:

Without abating our zeal or contracting our scheme of provision for general education, there remains much to be done by our city-school systems in providing that kind of instruction and training which fits persons, in part at least, for some particular mode of gaining a livelihood. The provisions for this purpose which seem desirable in the present stage of pedagogical experience and opinion are here briefly enumerated:

(1) A modification of the curriculum of elementary instruction which will render it better, not only for the purposes of general education, but also better as a direct preparation for many industrial pursuits. This modification consists, in brief, in throwing overboard a considerable mass of the useless details of some of the branches now taught, in applying more practical and comprehensive methods of teaching all the subjects, while always aiming at the shortest and most direct means of communicating and enabling the pupils to acquire useful knowledge, and at the same time ignoring processes and exercises merely for the sake of what is called symmetrical development of the mental faculties; thus making room for drawing (both freehand and mechanical), the rudiments of bookkeeping, the rudiments of practical geometry, physics, chemistry and natural history, modeling and carving for boys, needlework for girls. I omit the workshop for boys, because I think that up to fourteen years of age the above studies, in connection with gymnastics, would be more profitable as a preparation for apprenticeship, and I think boys ought to complete their elementary education at fourteen years of age, and, if they have not, the more reason why they should not then divide school work with shop work.

(2) To teach girls, in all grades of public instruction, sewing and cutting and fitting, and, besides, special schools should be established for instruction in the advanced branches of needlework, cutting and fitting, and perhaps millinery.

(3) To establish everywhere, in small cities as well as large, thoroughly equipped evening industrial drawing schools.

(4) Evening high schools should be widely disseminated, giving instruction in more or less technical branches, such as bookkeeping, commercial arithmetic, stenography, practical geometry, drawing, etc.

(5) Evening schools devoted exclusively to technical branches, like those in France.

(6) To establish in the larger cities one or more apprentice schools like that in Paris, on the Boulevard de la Villette.

(7) The establishment of simple manual-training schools, as they may be required, like those in New Haven, Boston, and Peru, Ill., for boys who have completed their elementary studies and for boys already in the grammar schools who wish to attend them out of school hours, whether in the evening or daytime.

(8) To establish in the larger cities manual-training schools, after the pattern of the St. Louis school and the school of mechanics connected with the Boston Institute of Technology.

(9) The general establishment of schools of practical cookery for girls, after the pattern of those which have been so successful in the city of London.

PRESENT PROVISIONS FOR INDUSTRIAL TRAINING INADEQUATE.

Reference has been made to departments in our principal universities for technical and scientific training in mining, civil and mechanical engineering, physics, and the natural sciences, and to other and more directly technological institutions for teaching low-grade science, and the character and plan of instruction therein pursued are illustrated at length in the appendix [Exhibit L]; but all these schools and departments, aggregated, are insignificant in number, and in most of them instruction in the mechanical arts has not been strictly adhered to, having been obscured by the literary and art-science sides of education, as therein taught.

TENDENCY TO IGNORE PRACTICAL SUBJECTS.

That this tendency is a very grave danger in technological schools generally, is very apparent from a study of those in England, where most of the institutions established purely and simply for technical instruction are already drifting into devotion for the higher branches of the natural sciences and mathematics, to the exclusion of drawing, applied science, and mechanical teaching.

Judge MacArthur says that while we have schools for all sorts of instruction in mathematics, history, literature and philosophy in abundance, they fit nobody with either knowledge or skill in any particular branch of industry. In the absence of provision for manual training and for a practical application of theoretical knowledge there is, of course, no acquisition of skill, but there is a notable tendency to beget dislike for those pursuits that require manual labor.

LACK OF MANUAL TRAINING.

It is high time that those interested in public education should display a danger signal in connection with our national system of elementary education, which *also* drifts to the *literary side* with a rapidity that should alarm our social economists. The storing of the memory with a multitude of extracts from books which, for a brief period after school life, may be retained and repeated as a proof of education, is altogether misleading and useless for boys and girls who must face the stern realities of making their own living.

SCHOOLS DEVOTED TO MATHEMATICS, PHILOSOPHY, LITERATURE, ETC., CREATE DISTASTE FOR MANUAL LABOR.

The character of teaching in the public schools of America is rapidly creating a distaste for manual work and industrial pursuits in general, and it would be well for our public teachers to make an earnest attempt to modify their instruction, in the direction of devoting more time to subjects of a practical nature, thereby promoting tastes for industrial pursuits based upon knowledge of the principles of the natural sciences applicable thereto.

DEFECTS IN EXISTING SCHOOLS AFFORDING INDUSTRIAL TRAINING.

Reviewing briefly the voluminous data showing the status of technical training in the United States, it is to be noted that, while provision for some kind of industrial education is now made in many of our universities and colleges, it fails to meet the greatest demands of the times in the following respects:

TOO EXPENSIVE.

1.—The instruction is too expensive for workpeople. But few of our mechanics and artisans could afford to pay the high tuition and meet the other necessary expenses, even if they had the means of support during the three or four years necessary to complete the course of instruction.

BEYOND REACH OF WORKPEOPLE.

2.—The course of studies in these institutions is much too far advanced for the mass of our people—the conditions of admission being so rigid and ar-reaching that only those persons who have already had superior school facilities are able to comply with them. Hence most of those universities and colleges that do make some provision for technical training are practically closed to the great majority of our laboring classes, who, being unable to pass examination on *all* the numerous subjects required for admission, are excluded from any of their departments of study. There are also radical defects in present methods of ascertaining the fitness of young people for pursuing technical studies. Those methods generally only develop how much cramming has been done by and for the candidates, whereas far greater consideration should be given the native ability, the previous educational facilities, the present circumstances, and the probable future career of the applicants. Many who, from lack of preliminary training, may not be able to take up and complete all of a prescribed course might still make good headway in special studies, if they could only be admitted to the classes.

TOO THEORETICAL.

3.—The instruction in most of our institutions is too theoretical. In order to benefit workmen and employers it should be better adapted to practical ends. Students in industrial classes should have greater facilities for visiting shops, fac-

tories and mines, and for studying their operations, and should be examined with reference to their proficiency in *applying* scientific principles to the numerous mechanical processes they witness, just as students of botany visit fields and forests and study flowers and plants, or as students of medicine go to the dissecting room to learn the human body, and to the laboratory for practical study of chemical compounds. For a mechanic to be able to dissect a machine that he has to run and keep in order, and to understand the nature of the material of which it is made and the office of each part, so as to be able to take the machine apart, mend that which is broken or out of shape, and put the whole together again, is just as essential as that the surgeon should understand the materials, construction and functions of the human body in order to repair it intelligently and well.

STUDENTS NOT TAUGHT TO OBSERVE AND TO DO.

But the students in most of our college classes know machinery only as they see cuts of it in their text-books. They study about wheels and pulleys and levers and screws, but rarely see them in operation. They learn the laws of electric force, without acquiring the mechanical power to properly arrange a battery when the materials are put into their hands. They learn the formulæ of chemistry, but are unable to undertake the simplest experiments without endangering their own lives and those of others.

ABSENCE OF EVENING SCHOOLS.

4.—Another important deficiency is the absence of provision for evening instruction of the masses of mechanics who are compelled to labor during the day for the support of themselves and families, many of whom would gladly attend evening classes for theoretical instruction, if accessible at reasonable cost. That this is true is proven by the large number of workmen in Europe and in sections of our own country who, of their own accord, attend evening classes when opened in technical schools, universities, etc. That many of these men and boys make commendable progress in their studies, even after working hard all day, is shown by the testimony of those having charge of such classes. Those of our colleges and universities having class-rooms, laboratories, apparatus and libraries already equipped could, generally, without great expense, make arrangements for evening classes.

EVENING STUDENTS IN OWENS COLLEGE, LONDON POLYTECHNIC INSTITUTE, AND COOPER INSTITUTE, OF NEW YORK.

In Owens College, Manchester, an institution of about the same rank as the Johns Hopkins University, several of the instructors of the day classes also give instruction to evening students, who number about six hundred. The class-rooms of the Polytechnic Institute at Regent Circus, London, are crowded to their utmost capacity every evening of the school year by young men and middle-aged mechanics who spend the day at work in shops. This school has accommodations for about three thousand students, and hundreds of applicants are refused admission every year because there is no room for them. Many who do gain admission to the classes succeed in passing the Government examination in science, or the city and guilds examination in technology. The fact that hundreds of workpeople in our own country avail themselves, with great profit, of the evening instruction afforded at Cooper Institute, New York [Exhibit L], and at the few other evening schools of merit in our cities, adds to the proof that there is a demand for increased facilities for practical instruction in evening classes.

In a recent special and comprehensive report on the present status of industrial education in the United States*—from which I have gained much information—the Commissioner of Education at Washington says:

VIEWS OF GENERAL EATON, U. S. COMMISSIONER OF EDUCATION, WASHINGTON, UPON INDUSTRIAL EDUCATION.

The manufacturer is aided by industrial education through the improvement of his products. His success depends on the demand for his goods at reasonable prices. This demand is regulated by the needs of customers. They ask for durability of material, attractiveness of design and excellence of workmanship in whatever they purchase for permanent use. Manufacturers' business improves as they become possessed of these and similar qualities, which can be economically secured only by the application of technical knowledge. Durability arises from excellence of raw material, and is retained by the selection of the right processes by which to convert it into the state in which it finally appears. The quality of raw material is not unfrequently to be determined by chemical tests, and many of the processes of its manufacture are regulated by chemical principles. The science which guides in the determination of these processes must be the one which will lead to their improvement

*Industrial Education in the United States. A Special Report prepared by the U. S. Bureau of Education. Washington: Government Printing Office, 1883. Pp. 319.

and perfection. Hence courses in chemistry are established in our principal polytechnic schools, as well as in colleges of agriculture (to which science chemistry makes liberal contribution), and in schools of mining and metallurgy. For a similar purpose engineers are taught to determine the strength of materials used in building railroads and bridges, houses and machines. Investigations in the domain of physics and chemistry have frequently taught the skillful application of new and serviceable agents to the production of labor. Men thus taught have laid out our railways, opened our mines, started and improved our manufactories and built our houses. They have aided in increasing our industries 35 per cent. in the last decade and in compelling an English confession that "the United States will probably pass us in the ensuing decade" in the value of her industries.

The elevation of the working classes is an inevitable result of educating them in industries. The direct effect upon the intellect is great and beneficial. The immediate moral influence is of the best. A manly feeling is awakened and kept alive by the consciousness of power and skill to do. An incentive to frugality and enterprise is set forth. It has been laid down as a rule by Prof. Edward Atkinson that—

"Other things being equal, high wages, coupled with low cost, are the necessary result of the most intelligent application of machinery by the arts, provided the education of the operative keeps pace with the improvement of the machinery."

Industrial education dignifies labor as well as opens doors to its skillful and remunerative performance. If labor has a noble end and purpose; if it employs intellect; if it abundantly rewards its servents, then it is worthy to be crowned.

The perfection of our manufactures, the facilitating of commerce, the unearthing of mineral wealth, the economizing of the fertility of farms, the dissemination of practical knowledge—these are ends which are being served by the graduates of our industrial institutions. These ends do not lack nobility. These forms of labor require the exercise of high intellectual powers. The attainments are of no mean order which enable a man to perform the great feats of engineering for which our country is becoming known, or which are required of superintendents of extensive factories. Even the doing of a single thing understandingly and well brings the doer respect from himself and his neighbor, and dignifies his calling. "It is the privilege of any human work which is well done," says Emerson, "to invest the doer with a certain haughtiness. He can well afford not to conciliate whose faithful work will answer for him."

The diminution of crime is to be expected from the diffusion of industrial education. The percentage of criminals who have received even the elements of an education is small. An authority on the subject has said that "one-third of all criminals are totally uneducated, and that four-fifths are practically uneducated." Yet when the relative number of convicts who are illiterate is compared with the number of those who have not learned a trade, it is found to be much smaller. It is stated by Dr. Wines that in Baden only 4 per cent. of the prisoners are unable to read when received, and that they are for the most part fond of reading, but that 50 per cent. have not learned a trade; in Bavaria 12 per cent. are illiterate, 29 per cent. ignorant of a trade. Mr. Charles F. Thwing a few years since claimed that 60 per cent. of the inmates of the Michigan State Prison had no trade, while less than 25 per cent. could not read, write and cipher; that in the prison of Minnesota 37 of 235 prisoners could not read and write, 130 never learned any business; and that in the Iowa Penitentiary the ratio of illiterate convicts to those unskilled in a trade was about 1 to 6.

Whatever may be the reliability of these figures, it cannot be denied that the lack of technical training is a prolific cause of crime. This lack is being supplied to some extent by some recently established schools, which both afford opportunities for such training and draw public attention to the existing need of it.

The introduction of industrial features into educational institutions has a tendency to relieve education of the accusation that it is unpractical. There are those that ask of our schools more than they are intended to furnish. Their voice in years past called into being manual-labor and half-time schools. Since the failure of these means to realize the expectations of their advocates, believers in education for industrial labors have been uncertain what course to adopt in carrying out their views. Now, it may be said with safety that the mass of our citizens are convinced that the educational systems and institutions of the country are above reproach, and will be modified by the introduction of new features as they are needed. A minority are disposed to be critical and assert that education is unwisely conducted, and that governmental aid might be applied more reasonably to the establishment of public farms and workshops for training purposes than to public schools.

Finally, protection to American institutions demands the industrial education of our youth, that they may carry our ideas of obedience to law and our republican principles into the midst of the multitude of foreigners that crowd our factories and our mines and perform much of our labor.

Ours is a peculiar nation. In it the principles of morality prevailing in civilized countries are upheld with warmth and reason. Our political principles are distinctive and characteristic. Daniel Webster enumerated them in one of his great speeches. They are the establishment of popular government on the basis of representation; the recognition of the will of the majority, fairly expressed, as having the force of law; the supremacy of law as the rule of government for all, and the existence of written constitutions founded on the authority of the people. He asserted his belief that the influence of town meetings in which American principles were recognized and followed, made those who went from them to dig gold in California "more fit to make a republican government than any body of men in Germany or Italy." If there be added to the lessons of our political gatherings and elections education in the essentials of government, instruction in the sciences contributing to human prosperity, familiarity with the languages of civilization, sound rules for the conduct of life, and training for an ennobling and enriching occupation, then American youth will be prepared oftener to fill leading places in industries, will win respect for their skill, learning and wisdom, and, being respected and trusted, will be enabled to enshrine American liberty more securely in the hearts of laboring men. So our land shall be the home of a safe and permanent nation, "where an industrious population advances like a victorious army, where the poor find work, the laborer becomes a proprietor, the proprietor grows rich, and all have the hope of a prosperous future," and the ends of our industrial education will be accomplished.

Common sense and experience combine in declaring that, to attain to eminence in science, art or literature, nations and communities must make liberal provision for institutions devoted to their study and investigation. A rudimentary principle of political economy is that, in direct proportion as money is invested in the endowment of such institutions with free professorships and scholarships, and the means for original research and experimentation, is its value compounded by their rapid advancement in those branches of knowledge which are the foundation of national prosperity. In recognition of this principle, the several States of the Union have

not been backward in endowing universities and colleges devoted to the study and investigation of one or more special subjects, and the *natural increase* of those institutions is sure to provide for the maintenance and the reasonable advancement of our literary and abstruse scientific status among the nations. Let greater provision, therefore, be made for the practical application of scientific and technical knowledge to our useful arts and trades, which are languishing in every branch. Whatever the cause of this depression may be, improvement in the quality of our products would go far towards stimulating demand and in restoring prosperity, just as it has done abroad in less favored localities and under more adverse circumstances.

DEVELOPMENT OF NEW INDUSTRIES.

Besides, there are numerous new industries awaiting development and the assistance which technical knowledge alone can give. Society tires of the old and a depression in business ensues; it clamors for the new and novel, in which, when produced, it is always ready to invest millions; thus affording employment to many workmen, the disbursement of whose earnings in sustenance, clothing and shelter for their families has a far-reaching effect in stimulating other industries. Witness the application of the recent discoveries and inventions in the domain of electricity.

THE USEFUL ARTS THE FOUNDATION OF INDUSTRIAL ENTERPRISE.

It has been shown that, in Germany, France, Switzerland, Belgium, Holland, and, later, in England, the promotion of the useful arts is acknowledged to be of the first importance, as lying at the foundation of all industrial enterprises, and in all those countries many of their ablest citizens devote their lives and scientific knowledge to improving methods of manufacture and the attractiveness and utility of staple products; to the discovery of new designs and to the origination of new industries; while great polytechnic and less pretentious institutes exercise a healthy and stimulating influence in the same direction.

MORE DEVOTION TO APPLIED SCIENCE AND TECHNICAL ARTS NEEDED.

A respectable class of our citizens, both young and old men of ability, devote themselves to a single branch or phase of literature, the ornamental arts and the pure sciences, while, considering the size and population of our country, the number who devote themselves from similar motives to *applied* science, technical arts and education—*i. e.*, not related to the social professions and fine arts—is really insignificant. When, in addition to some such plan as that outlined by Dr. Philbrick, our agricultural colleges are given the breadth, and are equally devoted to the several branches of instruction, intended by Congress; and when, by the rearrangement of present and the establishment of additional polytechnic schools, sufficient industrial instruction is afforded to meet even present needs and demands, the more important, at least, of our industrial trades will take their true positions as of equal respectability and value as the professions and the higher commercial pursuits, and then the (to us now utopian) condition will be fulfilled when our mechanics and artisans, like the peasants around Groningen, can cast "compassionate glances at all that population of shopkeepers, clerks, professors, officials and proprietors who, in other countries, are envied by those who till the ground, but here are regarded by them in the light of *poor people.*"

Industrial and Educational Needs of Baltimore.

COMPARISON OF BALTIMORE WITH OTHER LOCALITIES.

The foregoing statement of the development and present condition of technical education, abroad and in the United States, though only a brief and incomplete historical sketch, affords a basis for comparing Baltimore, commercially and mechanically, with other localities where higher scientific methods are practised in corresponding industries. Such a comparison seems absolutely necessary to awaken an interest in, and a demand for, more thorough and widespread scientific knowledge, the power and effects of which, in the arts, manufactures and trades, are portrayed in the preceding pages of this report; for it is to be observed that where the lack of scientific instruction and technical training is greatest, the want of it is least likely to be felt by those who are deficient in it. Realization of the need is generally followed by sufficient agitation to secure it.

BALTIMORE NOT PROGRESSING.

It must be painfully apparent to a large number of our business men, as well as to other thoughtful citizens that, notwithstanding her superior natural and artificial advantages and resources, Baltimore is not only not progressing, as compared with even less favored sections, but is not maintaining her former position in the commercial and manufacturing world.

CAUSES MUST BE UNDERSTOOD.

Whatever the causes of the general apathy that is paralyzing her business enterprises may be, they must be analyzed, the facts brought to light and their effects understood, before intelligent measures can be devised for producing a different state of affairs. Although it is never an agreeable task to criticise, in any relation, the community in which one lives, yet here, as in surgery, the diseased part must be bared and its condition made manifest before proper remedial measures can be determined.

REASONS FOR DISCUSSING THE INDUSTRIAL AND EDUCATIONAL NEEDS OF BALTIMORE.

The interests of our service are so interwoven with the commercial prosperity of Baltimore; the poverty of her youth in intellectual attainments and mechanical skill has been so painfully manifested in the preliminary examinations held the past year in connection with the technological classes at Mt. Clare, as well as in the current mechanical operations of the service that, in view of the intimate relations that must always exist between the educational facilities of the city and any technological institution that may be established within or near its boundaries, a discussion, in this report, of the needs of the city in the matter of technical instruction and its advantages, becomes pertinent—indeed necessary. Neither from professional education nor experience am I able to treat the subject exhaustively. But what is hereinafter cited is patent even to superficial observation, and if, through this citation, such general interest can be awakened in Baltimore as shall result in placing her industrial and technical educational facilities—which are of paramount importance to her prosperity—upon a par with those offered by rival cities, a great boon will have been conferred upon the community in general, and the Baltimore and Ohio Railroad Company and all other manufacturing corporations will enjoy the reflex advantages accruing from the increased intelligence and skill that her working-people will soon acquire.

NECESSITY OF UNITED EFFORT TO RESTORE PROSPERITY.

If those public-spirited citizens who recognize our deficiencies in this respect, and whose professional or business attainments place their qualifications and motives beyond cavil, can be induced to unite in devising and in securing the acceptance of an intelligent and practical measure for reviving and extending the industrial interests of the city, its commercial and manufacturing advantages are unquestionably such that it would soon not only recover its lost prestige, but would rapidly advance beyond the prosperity of many of its now successful competitors.

INDICATIONS OF A NEW SOUTH.

At this time there are indications of the birth of a new South—a South that shall become famous and wealthy, through the development of its immense resources and the application to its industries of scientific methods, which elsewhere will be of slower growth, because they will supplant and make worthless the expensive plants of present processes.

APPROACHING ERA OF NATIONAL PROSPERITY.

Standing as we evidently are at the threshold of another era of national prosperity, in which the South and other sections naturally dependent upon Baltimore (as the connecting link between the North and South) for manufactured products must participate, the present is an opportune time to make provision for industrial education commensurate with the needs and resources of the city.

METHODS HERETOFORE PROPOSED TO SECURE PROSPERITY HAVE NOT MET WITH GENERAL FAVOR.

The causes that have combined to relegate Baltimore to a rank so far beneath her true status as a commercial and manufacturing centre become readily apparent from a study of her industrial history. It is unnecessary to enumerate them here,

but it is pertinent to remark the almost invariable lack of appreciation, at times actually assuming an attitude of unreasoning antagonism, with which the efforts of those who have sought to promote her material prosperity have been received. Considering the widely divergent and irreconcilable views developed upon the presentation of many plans from time to time devised for the improvement of her trade and commercial relations, it is manifestly useless to hope now for fruitful result from any similar proposition which has not the merit of promoting at least the principal business interests of the city.

ALL INTERESTS MAY PROFIT BY TECHNICAL TRAINING.

Municipal industrial education, however, offers a program upon which every business interest may harmonize, with equal certainty of sharing in the ultimate prosperity which, as experience has shown, uniformly follows its general adoption in a trade centre, and which it can hardly be questioned would, in the case of Baltimore, prove equally—and probably far more—valuable than could reasonably be hoped for from any of the measures for increasing our general prosperity to which allusion has been made; while at the same time promoting the material, intellectual, and moral welfare of the masses of our population.

HISTORICAL RETROSPECT OF BALTIMORE.

During the period between the close of the Revolutionary War and the War of 1812, the city of Baltimore enjoyed its greatest prosperity, and at the end of the latter conflict it gave promise of becoming pre-eminent among the most prosperous commercial and manufacturing cities of the country. It was then that its growth was most rapid; new enterprises were readily undertaken, and its commerce was, relatively, if not actually, greater than ever since.

ORGANIZATION OF B. & O. COMPANY.

After the opening of the Erie Canal, its most astute business men, realizing that without more rapid and direct freight communication with the west, Baltimore must suffer greatly from the increased competing power of New York, as early as 1820 began an agitation for increased traffic facilities to the west, the outgrowth of which was the organization of the Baltimore and Ohio Railroad Company. Though constantly subjected to the attacks of rival corporations, to home opposition born of prejudice and jealousy, and to the more vexatious indifference with which its efforts to maintain and stimulate languishing industries have been met by those it sought to benefit, the Baltimore and Ohio Railroad Company is to be credited with diligent and consistent efforts to foster and enlarge Baltimore manufactures and commerce, and it is interesting to observe that, to the extent it and its affiliated interests have been conducted in a liberal and progressive spirit, they have expanded and prospered amid a general decadence of the city's industries.

SUPERIOR NATURAL ADVANTAGES AND RESOURCES OF BALTIMORE.

While substantially at its door are water powers capable of furnishing motive force for many times its present manufactures; while the advantages of its superior geographical relation to a large and productive section of country are preserved by its being the terminus of an extensive trunk-line system tapping that section at many points; and while it has within easy reach enormous reservoirs of the finest steam-making coals found in America, as well as generous supplies of iron, copper, hard woods, cotton, tobacco, and other material suitable for manufactures—in fact, all the staple raw materials, the conversion of which into manufactured products builds up those large industries and commercial interests without which no city can be great or prosperous.

LOSS OF PROMINENCE IN INDUSTRY AND COMMERCE.

Baltimore has practically lost all claim to pre-eminence or even prominence in any manufacturing or mercantile pursuit. Not only do many industries develop elsewhere, and which should be prospering here, not exist, but it has been impossible to maintain those we had, and yet the apathy of the community is such that no substantial response is made to the most urgent appeals for financial encouragement and assistance in increasing our commerce, reviving old or establishing new manufactures or kindred enterprises.

LOSS OF WEST INDIA SUGAR TRADE—EXTENT OF THIS LOSS.

To be more specific, I may remind you that Baltimore has, apparently through pure lack of energy, lost the West India sugar trade, and her iron industries are little short of the throes of dissolution. The gravity of the loss of this sugar trade is shown in a recent pamphlet prepared under the instructions of Mr. C. Morton Stewart, which sets forth the total value of the city's imports of sugar and molasses in 1874 as $10,598,227; decreased in 1884 to $107,041, but even these figures by no means represent the net loss to the city, in one decade, from this single item—the ten millions of imports merely representing the *raw material brought here;* to which should be added the commerce supported by its transportation, the repairs to vessels, the labor and the manufacturing industries incident thereto; all of which, when summed up, show a loss much more serious and far-reaching than that indicated by these bare figures.

HOW TO REGAIN THIS TRADE.

Were Baltimore now able to manufacture those articles for which West Indian products are exchanged, at prices and of quality that would compare favorably with the wares of rival manufacturers, thus directly exchanging manufactured goods at a profit for those products, instead of paying for them in specie and compelling incoming vessels to look elsewhere for return cargoes, we could, in a large measure, again attract this lucrative trade to our port.

DIMINISHED MARITIME COMMERCE.

Baltimore has entirely lost her reputation and renown in maritime pursuits, which at the close of the war of 1812 was world-wide, without gaining compensating advantages. Possessing a fine harbor and first-class shipbuilding facilities (includ- a dry-dock hardly surpassed in size and equipment by any other on our coast), she is yet debarred, through the unskillful work of her artisans, their trade agitations and prohibitory labor tariffs, from securing the construction of even the few coasting steamers registering at her port, while her shipbuilders are, from the same causes, compelled to decline bidding on the few ocean bottoms offering for construction here.

ABBOTT IRON WORKS.

The Abbott Iron Works, after a prosperous business career, have been idle for a long time, and are now about being sold and the valuable plant thereof distributed. The same general cause accounts for the depression in other branches of trade, with the details of which all citizens who, like yourself, take an active interest in the welfare of the city, must be familiar.

But it is unnecessary to multiply illustrations of neglected opportunities for enhancing our wealth and increasing our corporate and commercial importance, or of absolute loss of established trade, apparently from a species of dry-rot, incomprehensible, but very satisfactory to our more pushing rivals; for no one better than yourself appreciates the great disadvantages under which Baltimore now labors in her competition with other cities.

B. & O. REVENUES OFTEN HAZARDED AND SOMETIMES SACRIFICED TO PROTECT THE CITY'S INDUSTRIES AND COMMERCE.

It is sufficient for the purposes of this report to point out that, because of the city's commercial apathy, the Baltimore and Ohio Railroad Company has frequently been compelled to hazard, and more than once to sacrifice its revenues, in order to prevent the practical suppression of the trade of the port, in which the business interests of the city are common with its own.

EXAMPLES OF THIS.

To cite recent examples of this, you will remember that when, less than a year ago, the Baltimore emigrant business was threatened by her Northern rivals, the Baltimore and Ohio Railroad Company found it necessary to surrender the profit of the business in order to secure the maintenance of the few steamship lines running to this port.

Also, that though many attempts have been made to retain our coasting trade, such was their lethargy, that it was very lately found impossible to induce our merchants to subscribe sufficient money to insure even a line of steamers between Baltimore and Charleston.

INDUSTRIAL POVERTY OF BALTIMORE AS SHOWN BY REPORT OF COMMITTEE ON ESTABLISHMENT OF MANUFACTURES.

Probably I cannot more forcibly illustrate our city's poverty in respect to business enterprises generally, and to manufactures specifically, than by quoting at some length from the Report of the Commission on the Establishment of Manufactures, made to the Mayor and City Council of Baltimore in 1877, which contains much valuable information on the subject of which it treats, but which seems to have received much less consideration than its merits deserve. From p. 20 *et seq.* are extracted the following quotations:

These tables, which have been very carefully prepared, disclose the poverty of Baltimore as a manufacturing city with painful distinctness. Baltimore is (by Table B) shown to be far below the industrial average in the proportion of her workingmen to the entire population. There is one operative in every 5.2 persons in Wilmington; 1 in every 5.04 in Philadelphia; 1 in every 5.5 in Boston; 1 in every 5.8 in Cincinnati; 1 in every 3.6 in Newark, New Jersey; 1 in every 7.6 in St. Louis, while Baltimore has only 1 in every 8.1.

This deficiency of manufacturing hands is more than accounted for by a still greater deficiency of capital per capita invested in industrial pursuits. In this respect Baltimore ranks the lowest of any of our large cities—lower even than Louisville, Kentucky. In Philadelphia the capital in manufactories is $252 per capita; in Wilmington $235; in St. Louis $194; in Cincinnati $197; in Boston $188, while in Baltimore there is only $97 capital per capita so invested—less than half as much as Cincinnati has; just half as much as St. Louis has; only a little over half as much as Boston has, and not a great deal more than a third as much as there is in Wilmington and Philadelphia. The tables of bank capital and savings-bank stock and capital will show that in Philadelphia, Cincinnati, St. Louis and Chicago, the money which our citizens lock up in bank stock, ground rents, private discount banks and such securities, is by preference invested in productive industrial enterprises. In those cities, as the tables show, capital is used to buy materials and pay wages, and returns in the shape of values received for products manufactured. In Baltimore, on the other hand, capital is used to produce interest. While in neither case can it be truly said that capital is barren (since the hiring of money may be as useful as the hiring of sewing-machines or any other sort of tool or service), yet it is quite apparent that money used in manufactures and other forms of active production is more fertile than money put at interest, or in ground rents or land, to reappear in permanent improvements distributed over a period of years, or in houses and buildings. Capital in manufactures must turn itself over at least once a year, and it will be seen by comparing the column of capital (Table B) with the column of "materials," that more than the total capital of all manufacturing establishments is every year invested in the purchase of raw materials for manufacturing, and more than a third of the whole capital of such establishments is annually disbursed as wages.

Wages added to cost of material and the sum deducted from gross product gives gross profits of manufacture, expenses of course not being allowed for. Tested by this, we find that in Philadelphia manufactures in 1870 paid 47 per cent. on nominal capital, in Cincinnati 43 per cent., in San Francisco 47 per cent., in Baltimore 48 per cent., in Chicago 50 per cent., in Louisville 50 per cent., in Boston 61 per cent., in Wilmington 71 per cent., in New York 74 per cent., and in St. Louis 120 per cent. Unquestionably, these figures show an excess of capital to product in Philadelphia and Cincinnati, and a deficiency of capital to product in St. Louis, but they also show that manufactures are less profitable in Baltimore than elsewhere, when we come to deduct the heavy taxation and other charges to which they are subject here, and from which they are free in Philadelphia.

If now we turn to Table A, we will find our deficiencies set out in detail in comparison with smaller cities, and with rival and competing ones. Your commission do not need to do more than call the attention of your honorable body to the array of facts presented in this table, showing how we are surpassed, even in manufactures which we ought to monopolize, by the most inferior towns and cities. There is only one particular in regard to which your commission will dwell upon in the figures in this table, and that is in respect of the manufactures which are needed to keep up our mercantile business and domestic commerce with the South and with our own counties. In the item of agricultural implements, for instance, Chicago makes seven times as many, St. Louis five times, and Louisville three times as many as we do. In the item of fertilizers we are surpassed by Wilmington, not to speak at all of other and larger places. In the item of boots and shoes, leaving all New England out of the question, Philadelphia makes four times as many, and St. Louis, Newark and Chicago, all three, equal our production. Chicago manufactures more than four times as many bricks as we do, in spite of our facilities. In the making of carriages, etc., Cincinnati manufactures more than four times as much as we do, New Haven six times, and Wilmington and Chicago three times as much. In confectionery, while no city can rival Philadelphia, Chicago makes three times as much as Baltimore. Our cotton manufactures are not yet quite on a level with those of New London. In flour and meal Newark, Wilmington and Louisville are our equals, while Chicago makes three times and St. Louis fourteen times as much as we do. Chicago and Louisville beat us in furniture. The glass manufacture of Pittsburgh is fifty times as great as ours. In iron manufactures, leaving out the great centres of this industry, we find ourselves inferior to Chicago, and not much above Louisville, Newark, New Haven and Wilmington. In leather manufactures we are completely outstripped by all the large cities, by every city in the country, in fact, which has half our population. In liquors, distilled or malt, even Newark surpasses us. In machinery we are not equal even to small cities like Newark, New Haven, New London, Louisville, Wilmington, etc. In sugar refining, leaving out Boston, New York, Brooklyn and Philadelphia, we find St. Louis beginning to be our rival. Of paints we manufacture $400,000 worth; St. Louis $2,000,000. St. Louis makes ten times as much patent medicine, ten times as much saddlery and harness, ten times as much manufactured tobacco, as Baltimore; while Cincinnati makes twenty times as much soap and candles, and St. Louis four times as much as we do. In stoneware we make $127,000; Cincinnati $3,600,000. In sash manufacturing our products are a beggarly $145,000, against $2,300,000 for St. Louis, $800,000 for Newark, $500,000 for New Haven, $250,000 for Wilmington, etc. In short, the exhibition is in the highest degree painful and mortifying, and must cause serious apprehensions in the minds of all persons who know that it takes trade to make trade.

It will not be denied that this is an anomalous condition of things. Equally it will not be denied that manufactures bring wealth and population to cities in more certain and speedy ways than any other form of labor.

As Amasa Walker said upon this point: "It is without question true that in an equal manufacturing population will be found a greater accumulation of wealth than in an agricultural or commercial

population. One important reason of this is that a larger share of the population are engaged i production, and a larger amount of capital is employed. Women and children, who could earn bu little in agricultural labor (and none in commercial), can earn much in manufacturing. Manufactu ing need never stop, summer or winter, cold or hot, wet or dry.

BALTIMORE CANNOT ESCAPE COMPETITION.

These facts are not pleasant to contemplate, but they must be faced whenever a earnest effort is to be made to increase the prosperity of Baltimore, be the tim present or distant. It is idle to expect to escape competition with other cities, an equally idle to expect success therein under existing circumstances, or to depend fo municipal growth upon sporadic seasons of national or local prosperity; for in thes days of rapid travel, cheap and quick transportation, those centres best equippe with plant and skilled workmen will inevitably, in seasons of prosperity, substan tially absorb the profits of quickened trade. In the United States seasons of grea prosperity are succeeded by periods of stagnation of trade, which subject our insti tutions to great strain. During these recurring periods of business depression, an because of the dearth of staple and diversified industries of magnitude, Baltimor suffers disproportionately to other centres of trade. I am told that this strain wa particularly severe when, during the labor disturbances of 1877, traffic was inter rupted on her principal remaining element of commercial prosperity—the Baltimor and Ohio trunk-line system. Had the earning capacity of the city accrued, in an material degree, from manufacturing industry, the depression would not have bee so great.

MR. MATHER COMMENTS ON BALTIMORE'S TRADE DEFICIENCIES.

Mr. Mather, in commenting on the industry of our city, says: "Baltimore doe not possess any large distinctive manufactures; her trade is chiefly that of grai and timber export." Though a mere statement of fact, this quotation contains a reproach to our city, whose great opportunity is that of distinctive manufactures, and whose great want is an increase of productive capacity.

IMPERATIVE NEED OF GREATER INDUSTRIAL ACTIVITY.

It cannot be too often reiterated that we need greater industrial activity to afford employment to our citizens, to add to the value of our property, to increase municipal income, and to attract capital and men of business to our city. But at this time to what industry can our people point as, in a visible degree, drawing foreign population for permanent residence within the limits of their city? Or what inducement do they hold out to capitalists to bring wealth from other localities and settle here with a view to engaging in industrial pursuits? Our own citizens are phenomenally backward in investing in extended business enterprises, and in the absence of special inducements it is useless to expect aid from foreign business men or capital. Commercially our city will remain nothing more than a second or third-rate exporter of raw material until, within its corporate limits, this raw material is converted into manufactured products.

BALTIMORE CANNOT DEPEND UPON DISTINCTIVE MANUFACTURES.

Some cities depend for their prosperity upon the manufacture of special products, as witness Manchester, which so long enjoyed pre-eminence through its cotton textile fabrics, though it imported all the constituents thereof; Crefeld, a wealthy Prussian city, which depends for its prosperity almost exclusively upon its silk manufactures; Sheffield upon its cutlery, and Lynn, Mass., upon its manufactured products of leather. But, as has been said, Baltimore can boast of no distinctive manufactures. Our only hope of industrial prominence lies in the inauguration of a multiplicity of varied industries.

There is abundant testimony to show that a city's prosperity may result from a great demand for some local natural production, or even from limited markets where there is no competition. Of this we have an example in the city of Pittsburgh, whose wealth is dependent upon the iron and coal trade; as also in the oyster trade, of which Baltimore for many years enjoyed a substantial monopoly, and which is still of sufficient magnitude and financial importance to count as a chief element in the city's prosperity.

BALTIMORE'S OYSTER INDUSTRY DECLINING.

But this oyster trade can by no means provide support for our large population, and even respecting our oysters it is to be remarked, parenthetically, that for want of are, proper legislation and development, the beds of the Chesapeake are rapidly

decreasing in yield, and already the oyster industry of Long Island Sound has become an active and powerful competitor of, and bids fair to eclipse, our home trade. Unless, therefore, efficient means are speedily taken to replenish our waters, the time must soon come when "Baltimore oysters" will be as rare as "Baltimore clippers."

ABUNDANCE OF RAW MATERIAL AND CHEAP MANUFACTURE NO LONGER INSURE SUCCESSFUL COMPETITION.

In times past, a city like Baltimore, possessing within its boundaries (or by reason of cheap transportation, or favorable location, holding tributary to it) abundance of cheap raw materials might, if it possessed, additionally, facilities for cheap manufacture, successfully compete with less favored rivals, without much regard to the quality and finish of manufactured products. But in these days, when rival transportation lines distribute crude materials to competing points upon substantially equal terms, with little regard to long or short hauls, and when the cultivated tastes and luxurious habits which result from increased wealth create an active demand for superior quality and finest finish, such centres as are best prepared to turn out first-class articles will control the market.

POTENCY OF EDUCATED AND SKILLED LABOR.

It is just here that educated and skilled labor becomes a factor of the greatest potency, because, as has been shown in the first two sections of this report, while improving quality, it uniformly cheapens production to such an extent that the control of such labor has enabled many cities to overwhelm trade competitors who possessed cheaper raw material or better natural facilities. That we are totally unprepared to avail of any artificial means of bettering our condition is patent from the Report of 1877 already referred to, which in very strong terms sets forth our deficiency in regard to manufactures. However great the national and foreign demand for manufactured products might be, were all other factors present, the dearth of skilled and trained laborers in Baltimore is so great that it could not, to-day, compete with other cities in the manufacture of special—and not even of many staple—products.

LOW RENTS AND TAXES CONSIDERED.

Low rents and taxes and favorable laws have very great attractions for capital, and hence many towns, without possessing any special natural advantages, have received the impetus which resulted in their becoming large manufacturing centres purely as the result of a liberal municipal policy. But while exemption from taxation and other special privileges are influential in building up new and reviving and extending old enterprises, by inducing the investment of capital, yet, in the present era of active competition and small profits, a factor more important to their permanency *is the assurance of skilled and intelligent labor*, an abundance of which has been shown to attract capital far more than the other advantages enumerated.

COMPARISON BETWEEN BALTIMORE AND PHILADELPHIA AS MANUFACTURING CENTRES.

Comparison between Philadelphia and Baltimore aptly illustrates this. For commercial purposes no better, and for manufacturing purposes not so advantageously, situated as Baltimore, Philadelphia, first by offering special exemptions from taxation and other inducements for the investment of capital in manufacturing works and, later, by the establishment of such technical and industrial schools as the Mechanics' Institute, Spring Garden Institute, Franklin Institute, the Philadelphia School of Design, the Pennsylvania School of Fine Arts, the Pennsylvania Museum and School of Industrial Art, the Mechanical Department of Pennsylvania State College, Girard College, and the Philadelphia Manual Training School, has grown into and maintains its position as the second city in the Union, and as pre-eminent in its manufacturing and allied industries; while Baltimore, practically without technical institutions, except the meagre facilities of the Maryland Institute, and until lately with onerous and unusual taxation, has, as stated by the city's commissioners on the establishment of manufactures, substantially starved out its old, and prohibited the undertaking of new, manufacturing enterprises. We may deepen our harbor and make valuable additions to our natural and artificial facilities for trade and commerce, but, as Mayor Latrobe aptly remarked in his message (1877), "We should remember that it is not commerce alone, but commerce and manufactures together, which will insure the future prosperity of the community."

BALTIMORE'S BACKWARDNESS RESULTS FROM INSUFFICIENT TECHNICAL EDUCATIO

Comparison between the present condition of Baltimore and the industrial stat of many European cities that have experienced its vicissitudes only goes to corro orate the conclusion herein announced—that the backwardness of the form results from the insufficient technical education of our artisans and labore [Exhibits D, E and F.] Neither our immense resources in the shape of raw mat rials, our facilities for manufacture, our advantages in the way of cheap living an healthful climate, nor the offering of low taxes and rent, nor all these combine will effect, at this late date and under existing conditions of trade, the restoratio of Baltimore to its normal position among the industrial and commercial centres c the country. But if we crown all these advantages with that most potent of a agencies for promoting industrial prosperity, a combination of superior skill an intelligence on the part of our managers and workpeople, we may then hope t stimulate new business ventures and to see Baltimore once more taking rank wit the first cities of the nation. It is very generally conceded that no enterprise turn ing out products for sale can successfully compete in our own and foreign market unless superior skill and intelligence can be secured to conduct it.

NEW INDUSTRIAL ENTERPRISES WILL GO WHERE TECHNICAL TRAINING IS PROVIDED

Certainly then it is only reasonable to suppose that if special schools are essentia to success in any industry, men who desire to engage in that business would rathe go to a city where such schools are already provided than to a city like Baltimore where, before they can hope for success, they must be at the expense and troubl of establishing or helping to establish technical schools. We have an abundanc of crude labor, as well as of cheap and crude material; but preliminarily to con verting that material into attractive and useful products we must so train ou artisans as to make them at least the peers of foreign and home workmen followin kindred pursuits. Then, when men of means and enterprise realize that we offe them not only raw materials and the same concessions and liberal policy that hav proven so successful in promoting the corporate prosperity of Philadelphia and other cities, but likewise the necessary skill and intelligence to transform thos materials into marketable commodities, we may reasonably count upon the assist ance of outside capital in starting a host of manufacturing and kindred enterprises.

In every field where American enterprise has entered, it has asserted itself and has been fully recognized—especially in labor-saving inventions for agricultural purposes. What has been accomplished in agricultural machinery can be done in metallurgy, textile fabrics, wood-work, railway appliances, etc.

ABUNDANCE OF RAW MATERIAL TRIBUTARY TO BALTIMORE.

Nowhere are there cheaper or more extensive deposits of minerals, timber and other raw material than in the vast mountainous regions of Maryland, Virginia and West Virginia, tributary to this city. Ample capital is seeking investment in any business in which profit is reasonably certain; machinery embodying the latest designs of the inventor's skill can be procured; markets are accessible; what is needed is skilled and educated laborers to direct and carry on the industries which convert raw material into manufactured products. But skilled and intelligent workmen are not found to hand; they must be made.

BALTIMORE NOT NATIONALLY RECOGNIZED AS AN INDUSTRIAL OR TRADE CENTRE.

The foregoing may appear to be trite remarks, more suitable for trade reports or the proceedings of civic banquets than for embodiment in a report of this character, but they bear gravely upon the condition and prospects of Baltimore, which it is but too apparent to those who travel extensively is, nationally considered, a provincial town. It is a sad commentary upon our commercial importance that one seldom sees our special wares announced beyond local markets, nor paraded in the effective manner in which centres of far less size and wealth make known their productions or commercial advantages. During several extended visits to the Pacific coast I seldom heard Baltimore mentioned in business circles beyond the Mississippi river, save as the place whence oysters come and where St. Jacob's Oil is manufactured. Very recently the executive officer of the Board of Trade of Portland, Oregon (the second city in importance on the Pacific coast and claiming to be the wealthiest, *per capita*, in the country)—himself a Baltimorean—advised me that, though his office is constantly supplied with all the trade publications of every other exporting city of the Union, it was with the greatest difficulty and only after repeated efforts that he had succeeded in procuring for his board any statistical information concerning Baltimore's productions and exports.

WHY OUR MANUFACTURING ARTS LANGUISH.

The obvious deduction to be drawn from the foregoing facts respecting the city of Baltimore is that our manfacturing arts are languishing as much from the want of skilled and intelligent artisans and managers to direct their operations, as from the lack of capital, cheap raw material, or natural facilities for production, and, from what has been stated in the first section of this report, it is evident that, in order to stimulate our manufactures and trades into greater activity, we must afford our people additional and better opportunities than now exist for acquiring industrial training and technical knowledge of our established industries, and of others which might be inaugurated here, with profit both to capital invested and to the city at large.

THE REMEDY TO BE FOUND IN TECHNICAL TRAINING.

As one of the first steps toward securing much-needed additional facilities for the technical training of Baltimore's youth, there should be radical changes in the present methods and character of public instruction. I fully recognize how much easier it is to point out errors of administration than to suggest wise remedial measures, and how unbecoming it would be in any one to make such suggestions without special preparation and recognized fitness for the task. To change the character of public instruction in a great city like Baltimore is a very serious undertaking, and no proposition contemplating such action should receive serious public consideration unless sustained by irrefutable facts and arguments.

REASONS FOR CONSIDERING THE EDUCATIONAL FACILITIES OF BALTIMORE.

But while I conceive it to be altogether outside my duty, even on behalf of the material interests of our service, to propose lines for municipal policy, and while I believe your instructions will have been measurably executed when I shall have given you a clear idea of the character, extent and effects, in general, of technical training, and specifically of the beneficial results that may, with reasonable certainty, be counted upon to follow the inauguration of technological instruction in the Baltimore and Ohio service, I also feel that the character of tuition under the public-school system of Baltimore and the State of Maryland is of as paramount importance to any technological work at Mt. Clare as is the commercial prosperity of the city to the revenues of the Baltimore and Ohio Railroad Company. If, in order to secure in its staff and in the rank and file of its service the same (if no greater) skill, intelligence and consequent efficiency that our Northern and Western rivals enjoy, the Baltimore and Ohio Company is unable in the future, as during the past year, to procure from the great mass of population in Baltimore enough candidates for apprenticeship possessing the minimum elements of a grammar-school education to meet the requirements of the service, but must undergo the additional expense and labor of instructing its apprentices in those rudiments of English education which are absolutely essential as the groundwork for even the most superficial technical training, it will be well to consider whether economy and the best interests of the service will be promoted by continuing Mt. Clare as a construction station ; and whether greater economy and more satisfactory plant will not be secured by distributing its machinery among the company's repair shops, and depending for articles now manufactured at Mt. Clare upon those outside works which—by reason of their employes having acquired a higher knowledge of the scientific laws that underlie their trades, and greater skill and higher intelligence than prevail among the artisans of Baltimore—turn out with economy the highest grade of such products as we now manufacture.

It would seem that, in view of our large expenditure for free public schools, there should be no difficulty in securing educated boys for apprentices.

CITY SCHOOL STATISTICS.

The appropriations for the public schools of Baltimore aggregate about three-fourths of a million dollars annually, out of which nine hundred and sixty-three teachers are employed to conduct the schools. The estimated population of Baltimore at the present time is 400,000. The number of children and young people of school age (between 6 and 21) at the last enumeration in 1879 was 86,961 (it is now probably 100,000), of whom 52,970 were enrolled in the public schools in the year 1885-6, and the average daily attendance was 34,217. There are no statistics showing the number in attendance at the various private schools in the city. Of the 100,000 children and young people who ought to be in school, perhaps 95 per cent. of the males, and a large proportion of the females are destined to gain their own livelihood—a majority in the trades and manufactures—and many must, wholly or in part, contribute to the support of others.

NECESSITY OF ADAPTING EDUCATION TO WANTS OF THE PEOPLE.

The overshadowing importance of so shaping our system of education as to convert this great army of future citizens into intelligent and law-abiding men and women, who shall be able to maintain their self-respect by at least providing for their own wants, induces me, not only on account of the needs of our own service, but also from a consideration of the future well-being of the laboring masses and of the city of Baltimore, to unite with General Counsel Cowen in invoking your active efforts, "both as an officer and a citizen," in solving the important question how best to afford our working-people that character and quality of knowledge and training which will qualify them for conducting successfully the occupations of industrial life as they exist to-day, and which all interests, individual, corporate, municipal and national, alike require they should enjoy. In view of the peculiar identification that exists between Baltimore's political and educational systems, it is apparent that, to secure any substantial or valuable change in existing methods of education, will require the active countenance and support—without respect to political bias—of our entire business community, as well as of all other citizens of responsibility possessing knowledge of the conditions and needs of the city. Already many intelligent working-people are beginning to realize that if any improvement is to be made in their material condition, it will be through the proper education of their children in industrial occupations, and that therein, far more than in the false movements and agitations of trades unions, lie those elements which, properly fostered, will insure the permanent betterment of their condition.

BOTH LABOR AND CAPITAL MAY PROFIT BY THE RIGHT KIND OF EDUCATION.

It has been wisely said that "from domestic economy rather than from political economy will come the solution of the labor question." In thrift and industry, and in recognition, on the part of employers, of the justice and necessity of encouraging, in a practical way, all legitimate efforts of workpeople to improve their condition, surely lies the true solution of the great problem of labor *versus* capital; for you will have observed, from the historical sketch constituting the first part of this report, that in those localities where industrial education and technical training have been most promoted by employers, there, also, are the least friction and the least agitation of the complex and vexed questions constantly arising elsewhere between employer and employe.

VIEWS OF A NEW ENGLAND WORKINGMEN'S CLUB UPON THE EDUCATION OF WORKINGMEN'S CHILDREN.

In this connection I extract from the September number of the *New Princeton Review*, for the current year, the following citation from the proceedings of a New England Workingmen's Club:

We have examined the reports of attendance, and the courses of study, of many of the public schools in manufacturing towns in various parts of the country, and the impression made upon our minds is that the arrangement of studies is, in the main, adapted to the wants of pupils who take the full public-school, or high-school, course, so as to be prepared, or nearly prepared, to enter college.

We also find, by extended inquiry, that a large proportion of the children of laborers, especially in manufacturing and mining communities, leave school finally before they are fourteen years of age. It appears to us that the education of these children is, usually, peculiarly inefficient, and, as a preparation for practical life, of little utility, from the fact that they have been employed mostly in *beginnings* in various branches of knowledge, and have acquired but little that is complete in itself. The studies for pupils under fourteen years of age seem to be, in great measure, only a preparation for the work of the more advanced classes, and they are therefore of uncertain value to those who must leave school at the age mentioned.

We recommend that the club invite the co-operation of workingmen who are interested in education in the effort to arrive at some practical conclusion regarding the particular education which working-people need—the kind of knowledge or training which can be obtained at school which will be of most worth to them in mature life—and we suggest that it would be well to obtain and compare opinions as to a course of study, or different special courses of study, for boys and girls who must leave school at fourteen years of age.

We will add that it appears to us that such inquiries will be more likely to yield valuable practical results if some division is made of the subject of education, than if it is taken up as whole, or in an abstract or general way. The following is suggested:

1. It is desirable that the children of working-people should obtain at school knowledge and training which shall be, in some measure, complete in itself and available for use in after years regarding means and methods for the preservation of their bodily health. That is, they should receive specific instruction as to healthful ways of living, and in the care of their eyes, teeth, digestive organs, and other bodily faculties. The ordinary methods of teaching physiology in schools seem to us rather vague and ineffective, and, at any rate, not suited to the needs of the class of pupils we now have in mind. They should be taught the value of pure air and of pure water, and of some measure of out-of-door enjoyment, in relation to health of body and mind.

2. Laborers of all classes need far greater readiness in "the use of figures," in ordinary business operations with numbers, than is usually attained, even by the advanced pupils of our public schools. Our children should be trained to thorough efficiency in the use of the tables and rules used in measuring or ascertaining quantities of all kinds in actual business, such as brick-work, stone-work,

and everything connected with building operations; in the measurement of articles of merchandise, of surfaces and solids of various kinds, and in the methods of computation for interest, percentage, etc.

3. They should be taught whatever will be in the greatest degree serviceable in enabling them to make life interesting for themselves and for those about them, and should be early taught that they must depend mostly upon themselves for this object. As one of the best means to this end, they should be taught to understand, enjoy and respect the powers of the English language, and should be trained to speak and write it with directness and sincerity, so that while they subsist by the labor of their hands, the life of working-people may be made attractive and interesting to themselves by thought. We believe that the inefficiency of education, and the vagueness and uncertainty of thought or mental vision which it produces, are highly injurious to the interests of the working-people of our country.

SCOPE AND METHODS OF OUR SCHOOL SYSTEM.

In order to suggest intelligent direction for your efforts and those of other public-spirited citizens whose active occupations and pursuits forbid their giving this subject the close investigation and thought its importance and great scope demand, it is proper briefly to enumerate the proposed objects and methods of our school system, as at present conducted, and then invite attention to the views of those best qualified to make suggestions and recommendations for improving our present method of public instruction "in the interest of those working-people of limited means who wish their children to look forward to manual labor as the means by which they are to obtain a livelihood," and fitting it to the industrial conditions that must exist hereafter. It will be sufficient for this purpose and will prevent unnecessary enlargement of this report to review, very cursorily, the educational facilities and institutions of Baltimore; the character of instruction afforded and its bearing upon the industries that it seems essential to our interests to improve and promote—referring you to our annual school and other municipal reports for more detailed information.

ENROLLMENT IN THE PUBLIC SCHOOLS.

First and most important among our educational institutions stands the system of public schools. These comprise primary grades, enrolling last year 24,511 pupils; grammar grades, enrolling 13,381 pupils; city high schools, enrolling 1,163 girls; the City College, enrolling 630 boys; the Manual Training School, enrolling 120 boys. [Report of Commissioner of Public Schools, page 56.]

SUBJECTS TAUGHT.

The subjects taught in the primary grades are reading, spelling, elements of arithmetic, penmanship, drawing, and vocal music. The same studies, with geography added, are pursued in the grammar grade, which requires five years for completion, and physiology, history, grammar and composition, algebra, geometry, and elementary physics, are begun toward the close of the grammar course.

CITY COLLEGE.

The subjects taught in the City College, in addition to the common English branches, are English history, book-keeping, chemistry, natural philosophy, Latin, Greek, French, German, literature, algebra, geometry, trigonometry, calculus, astronomy, mental and moral philosophy, logic, and Constitution of the United States.

GIRLS' HIGH SCHOOLS.

The advanced studies in the girls' high schools are elocution, French, physiology etymology, music, algebra, drawing, literature, rhetoric, natural philosophy, geometry, history of the United States, mental philsophy, book-keeping, and astronomy.

OTHER PUBLIC AND ENDOWED SCHOOLS IN BALTIMORE.

The other public and endowed institutions accessible to residents of Baltimore are the McDonogh Institute, with a capacity for about 100 pupils; the Maryland Institute, with very inadequate accommodations for perhaps 500 or 600 students; the University of Maryland, for students of law and medicine; the State normal school and colored normal school for training teachers; and the Johns Hopkins University, which affords higher instruction to such students from different parts of the world as possess the high standard of qualifications necessary for admission to its classes.

SCHOOLS AFFORDING INSTRUCTION IN ART AND APPLIED SCIENCE.

With the exception of drawing in the public schools, but little is taught that serves to fit pupils for industrial handiwork. Of the schools professing to teach, in a practical way, the science and arts underlying the industries of this country, there

are only the Maryland Institute, the Manual Training School, and the McDonogh School. The first of these has to do with the arts and with drawing, while only the latter two pretend to teach applied science; and together, they afford instruction to fewer than three hundred boys, many of whom are in these schools for only a secondary purpose, expecting, ultimately, to become clerks, shopkeepers, or professional men.

EVENING INSTRUCTION.

At the present time in the city of Baltimore almost nothing is being done in the way of affording evening instruction to young people who are engaged in labor during the day. The attempts that have been made towards doing something in this direction by the public schools have not been very successful. No doubt one of the principal reasons of the failure is that the instruction offered to boys and girls has not been sufficiently practical to induce them to put forth the exertion required to enable them to profit by it.

BALTIMORE'S LIMITED FACILITIES FOR PRACTICAL TRAINING.

From these scanty statistics and citations it is readily seen that only a few schools, with very limited capacity and insignificant financial support, can be classed as affording our working population a knowledge of the sciences as applied in industrial pursuits, and, therefore, the members of this large class necessarily enter the usual occupations of life untaught in technical knowledge and untrained in manual skill. Lacking the technical knowledge and the manual training to perform intelligently and skillfully the operations of the manufactures and other kinds of industrial work they expect to pursue all their lives, they must waste years that should be devoted to school or to earning wages, in acquiring sufficient manual dexterity to make their services valuable even in this market, and in doing this they forget much of the temporary information acquired at school. Manifestly, therefore, in order to supply the missing link in our public-school system, something must be done to provide facilities for imparting information and affording training of a character that will fit the workingman's children for acquiring such scientific knowledge as can be utilized in their various occupations. Of the $715,362 appropriated by the city of Baltimore for public-school instruction for the year 1885, only $12,800 or 1¼ per cent. was devoted to conducting the Manual Training School, and this is the only purely industrial institute provided for under our public-school system.

DISPOSITION OF SCHOOL FUNDS.

The remainder of this very large sum is divided into sub-appropriations for the several grades devoted mostly to literary training. Included in this general sum is $6,000 for conducting evening schools, which, however, are devoted entirely to the common English branches. While only $12,800 is devoted to special industrial education, about $75,000—or more than 10 per cent. of the school appropriation—is annually expended in maintaining two high schools and the City College, which do little toward fitting their pupils (about 1,800 or less than 4 per cent. of the enrollment) for handicrafts—their curricula being intended to qualify pupils for clerkships and the learned professions.

THE CLAIMS FOR SPECIAL INDUSTRIAL SCHOOL FACILITIES ARE EQUALLY AS STRONG AS THE CLAIMS FOR SPECIAL LITERARY TRAINING.

As the Johns Hopkins University is exclusively devoted to higher education; as the Maryland Agricultural College is practically a cipher in affording technical training; as the Manual Training School, even were it an efficient institution, as in point of fact it is not, could instruct only 150 boys, or less than three-fifths of one per cent. of our public-school enrollment; as the Maryland Institute, with its meagre facilities and insufficient support, affords only special instruction in art and drawing, it may properly be said that Baltimore, with a population of nearly 400,000, a school enumeration of nearly 100,000, and an annual school expenditure of nearly three-quarters of a million dollars, is practically devoid of facilities for fitting her working classes for their life work. In view of these facts, I apprehend it is not overstepping the bounds of propriety to suggest, in this report, that those children whose circumstances or inclinations clearly point to an industrial career should have facilities for special training bearing on their life work relatively equivalent in extent to the facilities that are now afforded in our City College and high schools to those who expect to follow avocations of a different character. It is not intended by these remarks to claim that public-school instruction should fit persons for industrial pursuits alone, nor that it should attempt unduly to dispose children towards

those pursuits, but that it should afford opportunities for qualifying those whose circumstances and dispositions or genius point directly to industrial occupations, for that sphere of labor, just as it now fits others for literary work or the learned professions. That technical education has a claim on our municipal schools equal to that of literary education, and that industrial training deserves a place in our schools both as a necessary compliment to intellectual training and as a preparation for pursuits involving manual labor, ought to be patent to all.

TENDENCY OF OUR SCHOOL INSTRUCTION.

Without undertaking to discuss at greater length the efficiency or practicability of the instruction in our free schools, attention cannot be too strongly drawn to the fact that the whole tendency of our teaching is the imparting of temporary information to children, less than 4 per cent. of whom pass into the High School, and probably 90 per cent. of whom pass from our primary and grammar schools into various industrial occupations *before reaching fifteen years of age.* On this point I cannot more forcibly and gracefully present the deficiencies of its common-school system than by applying to the city of Baltimore the language used by Mr. William Mather, of England, in his testimony before the Senate Committee on Education and Labor, whose report on labor and capital has but recently been published. This testimony is a valuable *exposé* of the practical relations of our educational system to our industries and, besides being fertile in suggestions of value in reference to the American school system generally, bears directly upon the question now under consideration—the educational needs of Baltimore.

MR. MATHER'S COMMENTS AND STRICTURES ON OUR EDUCATIONAL SYSTEM.

Mr. Mather says:

In my travels through your country in pursuit of my inquiries, I have visited about twenty-two cities, and stayed at each for a while making inquiries. I suppose I have visited over one hundred institutions of various kinds, particularly schools and colleges, and I think I have a pretty fair notion of what you are doing in the direction of education, both generally and specifically. My opinion is, in regard to the question raised by your inquiry, that you would have an immense effect upon the condition of the working classes here if you would alter the methods of teaching in your primary and grammar schools, and very much also in the high schools.

After having given reading, writing, arithmetic, and those rudiments of education which you give thoroughly and intelligently—you seem in that respect to ground the children thoroughly well in the rudiments of education—you then seem to pile upon them a lot of studies which do not enter into their lives afterwards when they come to work, and you utterly ignore in all your public schools that element of industrial training which seems to me so necessary for every people—particularly a people like the Americans, so mechanical and industrial in their occupations.

Looking at the course of education of the grammar school, the graduates of that school everywhere appear to me to have spent a great deal of time on the refinements of grammar and of literature—education of very little consequence to them when they pass into their life-employments—and during that time they have no opportunity of acquiring knowledge of the natural laws or elements of chemistry, physics, or the various sciences that underlie all the industries that abound in the country, and into one or the other of which these children are passing. That is all a dark and unknown land to them, and I think it is a misfortune to the working classes of this country that their education runs so much to the side of literature, and not to the industrial and scientific side.

To illustrate how readily children can acquire such information, we have adopted in England, in our new "Board" schools, quite a different system. If you examine a boy of twelve to fourteen years of age in our new "Board" schools throughout any of our large cities, you will find that he will at that age know as much about the elements of simple mathematics, mechanical drawing, physics, chemistry, electricity, magnetism, and all those general elements of science, as many of your boys and girls do in the high schools when they are sixteen or seventeen years of age. That is not owing to the fact that our boys and girls are any smarter or more intelligent than yours, but is owing entirely to the system of education adopted. We are endeavoring to bring this natural system of education in our country to a point where it will be of use to the working classes chiefly; and we endeavor to teach them those subjects that will have a direct bearing on their future employments. Without teaching them a trade, or any particular handicraft, all the tendency of the teaching is to make them either commercially or industrially a success, in the way of having some scientific knowledge which they can utilize as they pass into their various occupations.

I find in this country what I should call lamentable want in this respect. I think it only requires that your public men, your educators, should take this into immediate consideration, in order at once to alter the curriculum of the grammar schools, so that a large portion of the time should be devoted to these more important subjects and less given to the facts of ancient history or remote matters, which the children will probably never think of when they once pass out of school into the ordinary occupations of life. * * *

Under the ordinary arrangements we are now trying to introduce industrial occupations generally, and we have thus far tried it to the extent of joinery or carpentry classes. We have in several of the Manchester schools put up sheds for carpentry classes, fitted up with benches, and turned every boy in the school, *nolens volens*, who is as much as ten years of age, into the carpentry class for three hours every week, dividing the time into three lessons per week. There all the various timbers from all parts of the world are collected, and a little lecture is given to the boys as to the character of the woods and what they are good for. Then each boy must take his tools and cut from a log a certain piece of timber, under the instruction of the foreman of the department. So each boy goes through the different lines of work in the department, always under instructions. This has had a wonderful effect on pupils, and has really increased their intelligence, so that the three hours lost from the other

departments of the school are not in fact lost, as the boys keep well abreast with the others in the other studies.

Q. You find this industrial education quite as beneficial to the intellect as the pursuit of the studies in the literary department?

A. Yes; it would almost seem to have revealed to us already that the proper method of training the intellect is to join industrial work to the teachings of the school. We find these boys are more capable of understanding the oral teaching and they understand better what they read. Their minds are made more reflective and receptive by the fact that they have depended more upon themselves and put into operation the knowledge that they have before acquired in the schools. That experiment has been tried, as you are probably aware, very extensively in France since the Republic was established there, and with very remarkable results. On seeing, in some cases, the benefits to be derived from that plan, we have made some experiments in England, and we think they are so satisfactory that we shall endeavor to bring to adoption in all our public schools some plan of industrial or mechanical training to go side by side with the intellectual courses.

Q. Will you be kind enough to give us the result of your investigations, if you please? We shall not often have opportunity to get it from so authoritative a source.

A. Well, I hardly think it would be quite pertinent to the question we are discussing. All I need to say is that I think the opportunities in France, Switzerland, and Germany for technical training have of late years become quite extensive. In all large cities the training is very thorough. If they err at all there, it is, as I think, that they theorize too much, and cause their students to imagine that, in passing through their technical schools, they have already acquired all the knowledge necessary to make them engineers, chemists, miners, etc., and that actual, practical work in shops, mines, and laboratories is not necessary. That is the evil that is encountered by their methods of teaching, and is one that I think neither Americans nor the English are likely to see in their own systems when they adopt anything of the kind.

As you know, your country does possess already a considerable number of very remarkable technical schools, which certainly are not surpassed by any school in Europe. They are schools, however, that are not available for the working classes, as are those of Germany, France, and Switzerland, and what little we have done in England. They belong to a higher rank in society, and therefore you have not felt them in your ordinary life. But for the training of skillful managers, foremen, and even proprietors of large industries, about a dozen of the schools and colleges of this country are not surpassed by anything in Europe. I need only to refer to the technological institute at Boston, for example. That form of school is purely technical, and, in the branches which they adopt for their course of teaching, they have a practical method of carrying out all the occupations, industrial and practical, in a simple form before the students which I think is much more to the purpose than anything done in Europe. The American mind is essentially more practical than the German or the French, and in these schools we see the effect of the difference. They keep their eyes fixed upon one thing—that these young men are to become masters or captains of industry—and, therefore, all the teaching has a strong practical bias. The State universities in this country—those coming under the national grant—would, of course, become excellent sources for technical and industrial learning, which might be utilized largely without costing much money, either to the State or to the community.

You seem to have a widespread—almost universal—opportunity for all the people here to get a technical and scientific education. All that you want is a shuffling of the cards to alter the curricula of the various institutions. There is more spent in this country for education than in any other country in the world—both I think by private beneficent individuals who have left money for certain colleges and universities, and, of course, by the generosity of your towns and cities in the public-school system—that is a fact of world-wide notoriety. I do not think the working classes here have anything at all to complain of in regard to education, except that it does not have a strong enough and close enough relation to the industries which the working classes pursue.

When you turn out nine-tenths of all the boys and girls in this country from the schools at the grammar-school age—fourteen or fifteen—you can see how important it is that at that age they have not been carried through that precise course of study which those may reasonably pass through who intend to pursue education up to the age of eighteen in the high school. I suppose it would be a very simple matter to make such regulations in regard to primary and industrial schools for those children whose parents intend they shall leave at fourteen or fifteen years of age, and not pursue the high-school studies; that in those cases such a change could be made in the curriculum of all the grades that the teaching should be more of an industrial character, and afford the information and training that will enable them to pursue their occupations more intelligently. That, I think, is a thing that the workpeople have a right to claim here—a revision of the course of instruction in the public schools.

One thing I have heard remarked by many Americans, and observed myself as I have gone through the country—that boys and girls just arriving at the age for entering into occupations involving manual labor rather seek what we call in England polite employments—to be clerks, or to be in stores, or some work that does not involve manual labor. Frequently there is considerable difficulty in some of the mills and manufactories in keeping there those who may have commenced to learn a trade or occupation, because they find manual labor uninteresting, as they are sure to find it when they have no knowledge whatever of the meaning of all this labor, or of the scientific truths underlying it all. Their respective powers are not interested; hence manual labor becomes a drudgery, and they soon leave those industries if they have opportunity. Most of your employers say they can not keep American youths at this work. They do not like manual labor.

We want to elevate and exalt the idea of manual labor in England. We do not want our public school system to give the children of the working-people the idea that labor is low, uninteresting, and vulgar. We want to avoid that by giving them opportunity to take interest in the sciences that underlie all our industries, and so imbue them, through that instruction, with an intelligence that will give them an enjoyment of life unknown to their fathers. That character of instruction it is not possible to get at such schools as I have described.

OPINION OF PROMINENT EDUCATORS.

At a joint meeting of the National Teachers' Association and the American Institute of Instruction, held at Saratoga in 1882, there was a report on Industrial Education by a committee previously appointed, consisting of General Francis A. Walker, President of the Massachusetts Institute of Technology; President M. C. Fernald, of Maine College of Agriculture and Mechanic Arts; President M. H. Buckham, of the University of Vermont; Prof. William H. Brewer, of the Sheffield

Scientific School, Yale College; William B. Weeden, of Providence, R. I., and John S. Clark, of Boston. This committee reported as follows:

Your committee chosen to investigate the subject of Industrial Education, and to report thereon to your association, beg to submit the following as their conclusions and their recommendations:

Your committee are of the opinion that there should be incorporated in the present scheme of public education broader provisions than now exist for imparting to our youth the elements of knowledge and skill required in the industrial arts; not alone for the development of those arts, but also as a part of the general system of public education, having for its object training for citizenship through the normal development of individual power.

To this end they would recommend:

First. The introduction into public schools of proper appliances for the development of the sense-perception of pupils, in regard to color, form, proportion, etc., by contact with models and with natural objects.

Second. The introduction into grammar schools of simple physical and chemical experiments for the purpose of acquainting pupils, through original observation, with the elements of chemical and physical science and their common applications in the arts.

Third. The teaching of drawing, not as an accomplishment, but as a language for the graphic presentation of the facts of form and of matter; for the representation of the appearance of objects, and also as a means of developing taste in industrial design.

Fourth. The introduction into grammar and high schools of instruction in the use of tools; not for their application in any particular trade or trades, but for developing skill of hand in the fundamental manipulations connected with the industrial arts, and also as a means of mental development.

In view of the fact that much misconception exists in regard to giving instruction in the several features recommended and of the desirability of more information in regard to their practical introduction into schools, your committee suggest a further examination into the general subject of industrial education and its relation to public education.

This testimony, officially published by so representative a body of practical educators as the National Teachers' Association and the American Institute of Instruction, hardly needs supplementing, though much more testimony to the same effect can be furnished, if needed, to serve the purpose in view. In lieu of more extended comment, I herein make a simple reference to Judge MacArthur's late book on "Education in its Relation to Industry," Charles Ham's new book on "Manual Training," and C. B. Stetson's work on "Technical Education," remarking that all of their testimony is in perfect harmony with the strictures contained in the quotations from Mr. Mather's report [Exhibit M] and those made by Dr. Philbrick [Exhibit N] in the report on the City School Systems of the United States, which is in itself a compendium of the subject.

INFLUENCE OF PUBLIC-SCHOOL INSTRUCTION IN DETERMINING THE FUTURE CAREER OF PUPILS.

In concluding the discussion of our public-school system I may remark that, broadly speaking, our lower and middle classes get no educational training beyond what is afforded in the public schools, and the direction given their studies greatly influences, if it does not entirely shape, their future career and consequently, in the aggregate, our social, industrial, and national life. This statement is simply a reiteration of the fact that if our school instruction, broadly considered, is to fit young people only for literary pursuits and the learned professions, our industries must languish for want of qualified persons to direct them and lack of skill and intelligence in the performance of the labor necessary to their successful development. On the other hand, if our schools are such as to fit young people for industrial pursuits, as well as for professions and clerkships, thus placing the professions and occupations requiring manual labor on an equal footing in point of dignity and qualified operatives, we may expect a systematic development of our national welfare. By giving more attention to scientific instruction, and to the training of the hand and eye, our public schools would not only do much toward meeting the present requirements of industry, but the reaction upon the schools themselves would be highly beneficial, and intellectual training would assume a high value in all grades of society. Teach the boys in our public schools that to be a carpenter, a machinist, or a moulder, is just as honorable, requires no less skill, and may be more profitable, than to be a clerk, or a doctor, or a lawyer, and there will be hundreds of qualified applicants for apprenticeship in our best shops, and soon educated labor will take the place of uneducated labor, and intelligent mechanics will displace those who refuse to learn more than they already know. But as matters now stand, with scarcely any facilities in our school system for even the most elementary technical training, few boys who leave the higher grades of our schools have any disposition to enter a workshop as apprentices; not because they have no mechanical genius or capacity for artisanship (for oftentimes their bent of mind is more in the direction of such pursuits than otherwise), but because their education has been such as to prejudice them against pursuits requiring manual labor and to predispose them toward some other sphere of activity which they look upon as more dignified and as giving them a higher social standing.

NEED OF FACILITIES FOR HIGHER TECHNICAL TRAINING.

It may not be gainsaid that Baltimore is sadly in need of additional facilities for those of her youth who are to become active managers of shops and factories or specialists in industrial occupations. While there are many considerations which should induce the State or our municipality to take immediate action in the direction of providing for the great educational want that has been shown to exist in our midst, one also not unnaturally looks for efficient help in the direction of the great University which has already become so conspicuous a part of our educational system.

REASONS WHY THE JOHNS HOPKINS UNIVERSITY SHOULD PROMOTE INDUSTRIAL EDUCATION IN BALTIMORE.

There certainly are cogent reasons why the Johns Hopkins University should co-operate to this end; prominent among which is the undeniable fact that its trustees are charged with the administration of a bequest that was primarily intended by the testator for the practical education of the youth of Maryland and the South. Upon casual reflection only, an extended reference to the character of instruction in that institution might not be considered especially pertinent to such a report as this, but as one of its principal objects is to secure for our service a sufficient number of young men possessed of such general and varied knowledge and technical training as will fit them for the many positions of responsibility in this service, in which vacancies are constantly occurring, and as many of these positions call for greater skill and a higher grade of education than are at present contemplated in connection with our Mt. Clare school, the curriculum and methods of the Johns Hopkins University become, as a matter of fact, of great moment in this connection.

RELATIONS OF JOHNS HOPKINS TO B. & O. R. R.

Such reference is further justified by the close financial and executive relations which the founder of that University sustained to the Baltimore and Ohio Railroad Company, and by the fact that the greater part of its endowment is vested in the securities of that Company, whose successful and economical administration is vital to its own prosperity and existence. If, therefore, some part of the large annual income which the University enjoys through this Company's operations ($136,236), and some portion of the services of its organized corps of experienced teachers and of its extensive equipment can be secured in aid of the higher training in mechanical and industrial pursuits of those to whom we must look for skilled and intelligent operatives, and of the children of our workpeople generally, than our limited facilities can afford, the interests of the Baltimore and Ohio Railroad Company, as well as of all other manufacturing corporations, and of the city generally, will be mâterially promoted; while the University itself would achieve great renown as the champion of high industrial education for the masses, and its trustees would, at the same time, relieve themselves of the blame which now attaches, in the minds of many of our respectable citizens, to their method of administering the Johns Hopkins bequest. The citizens of Baltimore are not alone in thinking that the managers of the Johns Hopkins University Trust have misjudged, not only the intention of its founder, but also the spirit and the want of the nation and of the present age.

MR. MATHER'S CRITICISMS ON JOHNS HOPKINS UNIVERSITY METHODS.

In this connection, I again call attention to that exhibit in the appendix of this report (Exhibit M) in which Mr. Mather regretfully refers to the devotion of this University to the highest mathematical, physical and medical sciences, and to its decided and especial bias towards original research and scientific discoveries in pure science and other theoretical rather than practical branches, and also to his further remark that "One might expect from so richly endowed an institution a more direct relation to scientific industry than now appears to be the case. With an income of $225,000 a year, it would appear possible for a larger amount of work to be done among the people of the city without in any degree diminishing the high class of instruction in the advanced stages of literary and scientific study."

THE UNIVERSITY IS NOT DEVOTED TO THOSE PURPOSES FOR WHICH IT WAS FOUNDED.

It is unquestionable that its splendid endowment has stimulated literary and scientific education; but, in view of Mr. Hopkins's well-known practical turn of mind and of those terms of his will which are susceptible of different constructions, it is important to consider the character of work to which the University is now devoted, in order to gauge its powers and influence in affording educational facilities to the youth of the States of Maryland, Virginia, and North Carolina, whose preparation for the practical pursuits of life and instruction in branches not taught under our common-school system, for which, in specific terms, it was incorporated and which it is also the testimony of his intimate associates the institution was founded.

AMOUNT AND DISPOSITION OF THE JOHNS HOPKINS BEQUESTS FOR UNIVERSITY PURPOSES.

The present income of the Johns Hopkins University is (closely approximated) $225,000 per annum, derived from an endowment of about $3,500,000; of which $2,207,900 is in Baltimore and Ohio securities. Making liberal allowance for the cost of buildings, apparatus, etc., it is ascertained that an average of considerably more than $100,000 has, yearly, since 1876, been expended for instructing an average each year of only 188 students; that the annual cost of instruction per student has been at least $700, and that each of the several teachers has had an average of not more than six students to instruct, for which services they have been paid salaries varying from $2,000 to $5,000 per annum. While these figures are approximate, it is certain that since the institution was opened for students more than $1,000,000 have been expended for the instruction of less than one thousand individuals, for an average of less than two years each. Considering the magnitude of this fund and the almost unparalleled expenditure per individual student, one might certainly look for encouraging results in those lines for which the trust was primarily founded; but, as a matter of fact, out of the 923 students who have matriculated during the ten years of its existence, *fewer than fifty have followed the occupation of merchants, engineers, electricians, manufacturers, or engaged in other industrial pursuits;* while all the rest were educated for professions not directly related to our industries.

THE COURSE OF INSTRUCTION IN JOHNS HOPKINS UNIVERSITY DOES NOT FIT FOR INDUSTRIAL CALLINGS.

Even the few who have gone from the University to engage in practical industry have done so by chance or from previous inclination, as the training received there did not particularly fit them for an industrial calling. Certainly those in whose behalf Mr. Hopkins's magnificent bequest was made have a right to expect greater results than these from the proper management of that fund.

WHAT THE PRESIDENT AND TRUSTEES MAY CLAIM AS THE RESULT OF THE UNIVERSITY WORK.

If the President and Trustees are asked what the University has done for the public, they will doubtless say that it has provided a large staff of able teachers, well equipped laboratories, and carefully selected libraries; that it affords broad and liberal courses of study; that it encourages original research and investigation, and that important discoveries have been made in science; that several serial publications are sent out for general and special information; that gratuitous courses of lectures have been afforded the public; that the University offers a number of free scholarships and fellowships to the meritorious; and, finally, that an average of nearly two hundred students annually receive instruction in its various departments.

QUESTIONS CONCERNING THE UNIVERSITY'S METHODS WHICH THE PUBLIC MAY PROPERLY ASK.

The public certainly have a right to ask what some of these important discoveries have been, and to know what practical bearing they have had upon the welfare of the community at large. The beneficial results of these discoveries have not yet been seen or felt in Baltimore. Most of the University's serial publications do not profit the general public of this city, because the matter contained in them consists largely of glittering generalities in science, mathematics and literature, that are of no interest or value to most people, while its public lectures are said to be of such a

character as to be understood and appreciated only by those who are themselves specialists, and who might easily go to original sources for the information thus afforded. Likewise it may not be out of place to ask who are the students upon whom the resources of this institution have been expended so lavishly. Are they from Maryland and the Southern States? Are they the sons of poor parents? Are they young men who have to work their way up in the world? Very few of them indeed have been drawn from the laboring classes or from those who are likely to take any part in industrial pursuits. As far as I can ascertain, they are the sons of the wealthy; they are young men who have already received a liberal education in preparatory schools and in colleges, and most of whose parents are amply able to send their sons to any of the already numerous high-class literary universities, such as Yale, Harvard, or Michigan. At any rate it is from this latter class that those who fill the Hopkins scholarships and fellowships are mostly drawn.

THE UNIVERSITY DOES NOT MEET THE MOST URGENT EDUCATIONAL NEEDS OF THE COUNTRY AND OF THE PRESENT AGE.

The present tendency of the Johns Hopkins University management savors too much of the classic and metaphysical scholasticism of the Middle Ages. In their efforts to imitate or surpass the great European universities, its President and Trustees seem not only to have ignored the educational needs of Maryland and the South, but of the entire nation. Our country is comparatively new. Very few of our citizens have leisure for the higher study of the classics, for speculative philosophy, or for the study of pure science for its own sake. The time has come when education ought to mean more than it once did. Proficiency in speaking Greek, in composing Latin verse, or in displaying dialectical skill, ought no longer to be the sole or leading purpose of a university training. As education ceases merely to lead a favored few into the realms of classic and philosophical thought, and begins to elevate whole classes of society by increasing general intelligence, and to dignify their labor by uniting the power of the mind with the skill of the hand, it will become a blessing as well as an ornament to society. The continuation of vigorous and healthful national life and development depends largely upon the aid which such education as this alone can afford. A hundred years later we may need to afford more extensive facilities than can now be had in our universities for the highest classical and philosophical culture of men and women, who may then be in a position to devote their whole lives to study and metaphysical discussions; but now we need educational facilities of a different character. Most of our citizens have to labor in some way in order to gain a livelihood. We have vast resources of wealth that are awaiting development. Specialists highly trained in industrial science are needed to direct our manufacturing and engineering enterprises. As a people we have a bias for the practical. Our citizens have a genius for invention. So great is their ability in this direction that, with scarcely any scientific or mechanical training, they have wellnigh led the world in the number and usefulness of their inventions. If now to this native bias we were to add the power that would result from intelligent training in applied science, and if we could give our artisans a chance to attain the highest skill and intelligence in the execution of their work, for what might we not reasonably hope in the way of national development?

ADVANTAGES OF A TECHNICAL DEPARTMENT IN A GREAT UNIVERSITY.

Why should not the Johns Hopkins University sustain a department for higher technical training in industrial pursuits? There are many reasons why such training can be better afforded in a great university than in a special technical school. The same library, apparatus, laboratories and class instruction would answer for both, in many departments of study. The association of the students in the regular University classes with those pursuing technical studies would be mutually beneficial to the students themselves and the country at large. This is shown to be true in the experience of such leading universities as Cornell and Columbia, where classical and technical students are daily brought together. Whatever serves to do away with antagonism, whether between labor and capital, or between industry and culture, ought to be availed of as a social and national blessing.

THE PRESIDENT AND FACULTY OF JOHNS HOPKINS UNIVERSITY FAVOR TECHNICAL TRAINING.

In certain branches, as chemistry, physics and biology, there are no more capable instructors anywhere than in the Johns Hopkins University, and I have no doubt that they would cheerfully render to the city and to this Company the assistance

they are so capable of affording, in any commendable effort for promoting industrial education. It is gratifying to be able to note, in this connection, that President Gilman and his Faculty seem to be in accord with the general idea here advanced. Professors on his staff have expressed and taken great interest in the question of technical training in Baltimore; some have delivered lectures to the working classes; papers on economics and kindred subjects, calculated to bring the University into intimate relations with the people of Baltimore, have been published, while its President has directly expressed his willingness to use the institution as a source of technical training as soon as a practical scheme to that end could be devised. [Exhibit M.]

THE TRUSTEES HAVE IT IN THEIR POWER TO FORGE THE MISSING LINK IN OUR EDUCATIONAL SYSTEM.

Is it, therefore, too much to hope that, all things considered, the governing body of this institution, recognizing that there is not now an extensive demand, in our locality, for such high-grade literary and philosophical study as is afforded in the Johns Hopkins University, will change their present policy (which appears to look to founding a university that shall favorably compare with the great literary universities of Europe), and will, aided by the city or through their own corporate individuality, forge the missing link in Baltimore's educational system, by establishing, in connection with the present course of instruction, a department of higher technical training, and thus more directly benefit the hundreds of thousands of our citizens, who can never hope to derive any practical benefit from the University as at present conducted?

BALTIMORE IS A DESIRABLE LOCATION FOR A TECHNICAL UNIVERSITY.

Besides the great demand in Baltimore for facilities for higher technical training, there are many circumstances that combine to make it a desirable location for a high-grade technical university. It is situated nearer than any other city to Washington, and the teachers and advanced students of such a school could have ready and comparatively easy access to the Smithsonian Institution and the Patent Office. These places would contribute much towards the success of an industrial course in the University, or of a separate polytechnic school. Washington is not sufficiently of a manufacturing city to sustain such a school. Baltimore is the only city that is close enough to the Capital to profit, educationally, to any great extent by the collection of models, scientific apparatus, and specimens that abound therein. In point of healthfulness, and moral and social influence, Baltimore is probably not surpassed by any other city of its size in the country.

ADVANTAGES OF HAVING SUCH A SCHOOL LOCATED IN OUR CITY.

Situated here, midway the Atlantic seaboard, a high-grade technical school would attract students from the North and the South, thus bringing about a better sectional feeling and widely disseminating knowledge of the resources of both the Northern and Southern States. The effect upon our own city would be beneficial in many directions. We would have finer architecture (in which we are sadly deficient at the moment), better sanitary measures, and a greater manifestation of public spirit in all deserving enterprises on the part of our citizens. A polytechnic school, or technical department in the University, would supply a gap in our educational facilities between the education afforded by the common schools and the high scientific and literary education offered by the Johns Hopkins University. It would exert a very healthful influence upon the public schools of the city, by modifying their course of study, by furnishing trained specialists to teach technical subjects, by stimulating young people to avail of their advantages so as to pass into the technical school, and by demonstrating that education is an important factor in fitting young people for skilled labor and industrial pursuits generally, as well as in fitting them for clerkships or soft-handed professions; and thus those callings involving industrial dexterity and knowledge would, in point of dignity and of qualified and intelligent operatives, soon secure an equal footing with what are popularly known as the "learned professions." A good high-grade technical school in our midst would do much towards supplying competent teachers and suggesting a practical course of study for our evening schools, and for secondary technical schools that would spring up, and the more ambitious of the pupils from such schools would have something to stimulate them to greater exertion; for, besides competent teachers and suitable instruction, there would be the additional incentive of making sufficient advancement to secure admission to the higher technical school.

It is well known that many young people in Europe fit themselves for the higher technical institutions by attending evening schools. Finally, with facilities for both higher and secondary technical training to supplement the general education now afforded in our public schools, we might reasonably hope that the frequent labor troubles resulting from the apparent antagonism between capital and labor, or rather the real antagonism between capital and uneducated labor, would cease; for educated labor would soon supplant uneducated labor in all our leading industries. Intelligent mechanics will do more for themselves and their brethren than any number of "labor agitators."

EXTRACTS FROM AN ADDRESS OF HON. S. TEACKLE WALLIS.

I cannot better close this section of my report than by quoting the following from the address of Hon. S. Teackle Wallis, before the Maryland Institute, June, 1882, to which Mr. Cowen called your special attention:

Can we let our people go untaught of the arts of construction and design, when all the sister communities with which we rank ourselves are straining every nerve to teach them? Are the mechanic arts so small an element in our prosperity that we can safely let them run or rust in the worn-out grooves of thirty years ago? When the demand all around us is for skilled workmen, are we to settle down without skill? Are the people who are born to the necessity of labor to be furnished with no means of lightening and refining it? Do the best we may, we can never dispense with the proletary and the drudge; but in heaven's name let us help him, if we can, to something better—let us make the hewers of wood and drawers of water as few as may be. This is not only the duty of a republic and Christian community, but its best interest as well. Think of the weariness that will be lightened by art labor of those who are weak and yet must toil. Think of the penniless and helpless women who will have pleasant and congenial work away from rude contact with piteous temptation. Think of the young men of poor estate whose tastes will be developed, whose natures will be refined, and to whom avenues of independence and perhaps distinction will be opened. Can any man look another in the face and say that these things are not to be coveted? And yet how shall we attain them? The children of toil cannot educate themselves. Of the many even to whom work brings comfort it brings but little more. As maturity comes on the son takes up the father's tools, and his education for the most part ends. What the workshop teaches him, more or less rudely, he learns, and little else. Unless some one helps him to improvement and development, it is only exceptional that he ever reaches them. Individual help may serve in individual cases, it is true, but a large and public need can only be supplied by public effort and the public hand. * * * In this city of ours, and this year of grace, there is not one single public academy of art of any sort except that within whose almost naked walls we are. The elementary instruction in drawing which is given in our public schools is necessarily limited, and a large portion of the pupils are compelled to leave at an early age, as the report of the Commissioners explains, in order to learn trades for their future support. * * *

It has long been my own conviction that one of the most direful needs of education in this State is the establishment of a technical school for scientific mechanical instruction. There is absolutely nothing of the sort upon the soil of Maryland—a blot indeed upon the intellectual and the business record of a community whose productive and mechanical capacity is so large and varied as our own. The class for whom such instruction is needed, are the very ones who cannot afford to seek it at a distance; and except out of Maryland, no Maryland man can find it. Every one who is at all familiar with the subject knows that in the large enterprises where mechanical agencies are needed, the demand is now for mechanics, not only skilled, but thoroughly and scientifically educated. The so-called "practical man," whose knowledge is simply empirical, and whose facts lie isolated in a vacuum, is fast being pushed to the wall. He is a victim of the survival of the fittest. Our mechanics are at a sad disadvantage, from the absence of opportunity to qualify themselves for this new order of things. An honorable and lucrative profession, which may well be classed among those best deserving the appellation of "learned," is thus practically closed to a large number of the most vigorous intellects of our State.

ADVANTAGES TO RAILWAY INTERESTS OF SCIENTIFIC TRAINING OF WORKMEN.

All that has been set forth in the preceding sections of this report may be considered as paving the way for an intelligent consideration of the bearing of scientific and technical training upon railway interests *per se*. The wide scope and the importance of the subject bewilder the investigator who seeks to know why technical instruction has not more rapidly advanced and prospered in this country, where the field of industrial enterprise is so wide, and what its effects are upon interests with which railroads are directly identified. An early recognition of the difficulty of securing a proper appreciation of the necessity for more thorough and widespread scientific knowledge among railroad people, led me to afford you a comparison of how it has affected manufacturing and kindred interests in those localities where it has been sufficiently and systematically cultivated, with other places approximately similarly situated with respect to trade facilities and competition, but which have despised or disregarded its aid. This preliminary presentation materially narrows the discussion of technical education from our particular standpoint, and yet I approach this division of the subject with great diffidence, and with full recognition of the pitfalls surrounding one who, lacking experience in many practical details of railway operation and of those industries that have to do with the production of railway plant and appliances, attempts or suggests reformations or modifications of time-honored methods and practices.

RAILROADING AS A PROFESSION.

Considering its importance and magnitude, there has been a singular dearth of discussion and testimony upon the subject of technical training for railway officers and employes. While there seems to be a general agreement that, because of the enormous capital and allied interests involved, and of the technical knowledge and skill necessary to successfully conduct its varied and far-reaching operations, railroading has acquired the dignity of a profession, fully as exacting and requiring equal professional skill and intellectual attainments as the liberal professions.

ABSENCE OF FACILITIES FOR THOROUGH AND SYSTEMATIC TRAINING OF RAILWAY OFFICIALS AND EMPLOYES.

I fail to find that any of our railway managers have a proper appreciation of the situation, or that there has been any well-digested effort in the direction of educating railway officials or employes upon systematic lines, such as, for example, produce at West Point and Annapolis corps of young men whose basic education and training, with a little experience, fit them for any position of responsibility and trust in our military and naval service. Unquestionably there must be in many of our large railway organizations those who have long recognized the need of, and would warmly welcome, this educational factor in railway management, and doubtless many of them are, from previous education and long experience, peculiarly qualified for making a forcible presentation of the advantages of—and in view of the great changes that scientific discoveries are making in methods of production and transportation, and the new industries that are continually springing up, I may say the absolute necessity for—a combination of scientific and technical education for the operatives of the transportation service of the country. But, unfortunately, men of this type are, as a rule with few exceptions, overtasked with responsibilities and harassed with anxieties that leave few opportunities and little inclination for expressing their views on any subject foreign to their specific duties.

DEARTH OF TESTIMONY AS TO EFFECTS OF TECHNICAL INSTRUCTION UPON RAILROAD INTERESTS.

Having accepted the task of investigating this subject, I shall endeavor to crystallize for you the testimony of such well-known authorities as, though not actually railroad men, have themselves been connected with the details of industries more or less related to railway interests, and who are, therefore, competent witnesses; and I shall further endeavor to set forth as clearly and succinctly as possible, such conclusions and considerations as have been evolved from a careful and somewhat prolonged inquiry and study of this subject from various standpoints.

ALL APPOINTMENTS OF RAILROAD OFFICERS IN LINE OF PROMOTION SHOULD BE BASED UPON HIGH STANDARD OF QUALIFICATIONS.

I do this in the hope that my labors will be fruitful of results in the direction of at least stimulating those in our service who have its welfare at heart (and especially those officers who are charged with making net results) to inaugurate a new policy, which shall require of all candidates for all positions, however insignificant, that are in the line of promotion, a reasonably high standard of qualifications, and shall then look to fostering and developing the youth of the service into a corps of educated operatives, mentally and mechanically skilled in their various handicrafts, with at least sufficient breadth of knowledge and capacity to render unnecessary and unjustifiable the selection of men outside the service to fill the highest positions of responsibility and trust, even in the administrative and executive staffs of the company. Such a policy would not be chimerical, but one easy of accomplishment with (considering the interests involved) an insignificant expenditure, if accorded the hearty good-will and co-operation of those upon whom devolves the duty of developing our resources and increasing the net earning capacity of our system.

If the testimony previously set forth affirmatively shows that scientific and technical education stimulates, develops and secures economical processes in the manufactures and other industrial avocations, a much stronger case can be made out in favor of broad technical education in connection with our railways; which, collectively, employ in the production and repair of plant, more workmen than are engaged in any other class of commercial business.

SCIENTIFIC KNOWLEDGE SECURES ECONOMY IN ALL RAILROAD DEPARTMENTS.

In the same ratio that our extensive railway system surpasses all other branches of industry in the magnitude of its business, the number of its departments and the interests affected, is there greater need for economy of administration and greater necessity for the application of the highest obtainable scientific knowledge and manual skill to its various operations. It has become the almost universal practice of our great railway corporations, and especially those whose lines are reaching out into undeveloped and sparsely settled territory, to assume the entire repairs of their plant, even when they amount to practical reconstruction, and there is also a steady tendency on the part of such companies in the direction of manufacturing their own equipment from raw materials.

RAILWAY CORPORATIONS HAVE BECOME MANUFACTURERS.

This places them in the category of manufacturers, and makes them amenable to the laws and factors regulating production, and, further, makes applicable to them much of the testimony heretofore given as to the value of technological instruction in mechanical pursuits. Because of the nature of their service, involving the transportation and care of many lives and valuable property, no less than as a matter of economy, is it of prime importance to such corporations that, in the construction and in the repair of their rolling stock and appliances, they should employ workmen of exceptional competency. It is unnecessary, in this connection, to comment upon their great responsibilities as guardians of life and property, but from a merely sordid point of view a few illustrations will demonstrate that, in their extensive mechanical operations, economy and credit result from the employment of intelligent laborers, who understand the theory and purposes of their work, and who have the scientific knowledge that gives them, beforehand, a realization of the proper quality and quantity of material to be used, and enables them to anticipate the results of the labor they must expend upon that material to produce given results; *per contra*, that corresponding danger and loss result from the employment of workmen who, lacking this knowledge, are compelled to experiment upon their material, and who require constant supervision, instruction and re-instruction.

METHODS OF TRANSPORTATION REVOLUTIONIZED BY WATT'S INVENTIONS AND INTRODUCTION OF STEAM.

The fact is that with the discoveries or, more properly speaking, inventions of Watt and the introduction of steam as a motive power, began a new and eventful era in the history of mechanical science. The wonderful development of land and water transportation that followed the inauguration of steam locomotion created a demand for a class of operatives, artisans and mechanics before unknown.

EVOLUTION OF "PRACTICAL" MEN.

Entering upon a new field of operations wholly unrelated to their previous experience, without preparation or present instruction, save what they absorbed in the performance of exacting duties on the railway, in the workshop and in the engine and boiler-rooms, men who had been "picked up" from many walks of life, and who altogether lacked scientific training, would naturally be guided solely by "rule-of-thumb" practice, and their lives were sure to be narrowed, until they acquired a pride in being known as "*practical*" men—a term nearly synonymous with the habitual but unreasoning work of many familiar species of the brute creation.

DEFECTIVE METHODS OF TRAINING APPRENTICES.

The railroad workman of to-day is largely the outgrowth of this condition of affairs, and yet is not wholly responsible for his educational deficiences. When learning their trades railroad apprentices were generally placed under "*railroad men*" of the "*practical*" type I have described; who despised or affected to despise scientific knowledge and scientific methods of operation; generally not because they understood or were able to weigh their bearings and value upon their pursuits, but because, knowing absolutely nothing about them, they thought thus to disguise their ignorance. Under such circumstances apprentices received little if any special instruction, but were mostly left to pick up their trades as best they could. Of course, under such a system, instead of having their special aptitudes developed they, in turn, became "*practical*" men; and of this type is the present rank and file of railroad operatives. It is therefore not remarkable that blunders and accidents frequently occur: that the lives and property of the public should be entrusted

to men whose limited knowledge frequently does not enable them to judge of or to reflect upon the responsibilities attached to their several duties, painfully illustrates the recklessness and indifference to public duty that characterize our age and country.*

RAILWAY COMPANIES DEPENDENT FOR SUCCESS UPON THE COURTESY AND INTELLIGENCE OF THEIR EMPLOYES.

Perhaps no large class of men are more subjected to public observation and criticism than the employes of transportation companies, and there is certainly no other class that can more materially promote their employers' interests by the exhibition of such courtesy, manly spirit of accommodation, and general information upon current topics as a fairly liberal education manifests, and yet you cannot have failed to notice—and as a railroad manager to regret—what is so commonly commented upon by the observing: the intellectual deficiencies and narrow-mindedness of this very class. That our railway operatives are one-ideaed is small matter for wonder; it would be more remarkable if, as a class, they were otherwise. I have already pointed out that the operating departments of a railroad which most expose their employes to public observation are those which require the longest and most exacting apprenticeship for the acquisition of that degree of knowledge and expertness which secures the performance of their functions as public carriers with safety and dispatch; that the heads of administrative and operative railway departments, who must of necessity be men of technical knowledge and familiarity with all the intricate workings of their respective branches, which can only be acquired by progressive service, generally commence their careers in the lowest grades, with little or no preparatory education; and yet their duties throw them into constant contact with a public which is indifferent to the measure of their experience, but which judges them by the standard of business men, and demands of them gentlemanly courtesy and general and varied knowledge, and which, I may add, favors or obstructs the operations of a railway company according *as its officials* are judged worthy of commendation or condemnation. The managers and owners of railway property are the ultimate sufferers from the deficiencies and derelictions of subordinates in this regard, and yet *they* are mainly responsible; for if, instead of exacting a high standard of qualifications on the part of applicants, they open their service to uneducated boors and then fail to provide them with facilities for acquiring, with manipulative and technical skill, at least the rudiments of those branches of knowledge and the opportunity for extended observation without which no man can be intelligent, liberal, progressive, how can it be expected that those employes, when taxed with the cares and anxieties of an active business, shall display such enlightenment and refinement as will reflect credit upon themselves and service?

LACK OF GENERAL AND TECHNICAL KNOWLEDGE AMONG RAILWAY OPERATIVES.

Many of our railroads employ *armies* of people, all of whom are supposed to be technically expert in their various avocations—and they need to be Even a good track laborer is not found ready made. It is a well-known fact that in many railroads only one or two men in a road gang know how to properly tamp a tie so that it will not require resetting the same season; and I know of extensive lines that do not possess a foreman—perhaps not a supervisor—who can adjust a curve with instruments. Does it not behoove executive and administrative officers who are

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*That this is neither an unjust nor groundless statement can be easily proven from the abundant evidence before me, and also from personal experience. In too many shops apprentices are looked upon as convenient lackeys, and although they may have strong predilections for certain kinds of work they are more likely to receive rebuff than encouragement in attempting to utilize their abilities. It is very probable that much industrial usefulness both to employers and society has been blighted in the bud from lack of recognition and wise direction.

A very interesting article, opportunely appearing in the November number of the *Century Magazine* (Vol. 33, No. 1) as this report is passing through the press, very fully discusses "THE NEED OF TRADE SCHOOLS," and especially this particular point of apprentice education, and in that connection I commend it to your notice.

Mr. Robert Thomas Eadon, an English manufacturer, says: "I am fully impressed with the importance of technical education. Some time ago I was in Bradford, and I saw that preparations had been made worthy of the town. There is no trade, however wanting it may be in taste or form, that does not benefit in the hands of a tasty man. One great reason why technical schools should be encouraged is because of the very great division of labor that takes place in some of the largest engineering establishments. There is a great tendency to put a boy at one machine, and he understands but little beyond that machine. The result is, though he has been in an engineering shop, he has no idea of the work carried on as a whole, when he comes out. He is a helpless man if you take him away from that one machine. It may not be always to the interest of excellent workmen to inculcate their skill in the minds of the boys under them; in fact, they may not have time to do it; but the advantages of a college or school of this kind will be that if a youth has a desire to improve himself, the facilities will be offered, and at such a rate as would be attainable."

entrusted with such vast interests as those of railroads to look well to the qualifications of their operatives? A recent and generally accurate writer has fixed the value of railroad property in this country at one thousand millions of dollars. Another writer says that the number of skilled laborers required in the operation of railroads is much greater than is commonly supposed, embracing large numbers of men not usually classed as railroad operatives. In such extended enterprises the efficiency of the unit—the individual workman—becomes an item of grave economic consideration, for if it be true that the value of the individual's work (whatever it be) is increased through greater intelligence and special training, though it be only by a few cents per day, the total is of no inconsiderable moment, when his services continue through a series of years and when, instead of one workman, thousands are employed.

THE ECONOMIC VALUE OF SPECIAL TRAINING FOR RAILWAY OPERATIVES.

If even a slight deficiency in the skill and intelligence of one workman makes a few cents' or a few dollars' difference in the cost of the products of each week's labor; if the incompetency of one foreman or one manager lacking scientific training does usually—as so positively stated by competent authorities—net an appreciable loss; multiply the result to corporations like, for instance, our Eastern trunk lines (one of which employs at least 50,000 people on that part of its system east of the Ohio River, and more than half as many more west of it: others may exceed or nearly equal this enormous force); realize that in such extensive organizations few if any of the practical details of the operating departments can be accurately gauged by those whose interests are most vitally concerned; comprehend how many important matters, involving grave consequences in their execution, must be entrusted to superintendents, master mechanics and foremen; then obtain a correct measure of their education and general knowledge (to say nothing of their scientific attainments), and you will begin to appreciate the importance and bearing of this question of technological education, and the enormous losses the lack of it yearly entails upon investors in railway securities.*

FIDELITY BUT ONE OF THE ELEMENTS CONSTITUTING A VALUABLE RAILROAD OFFICER.

That most of those who have risen to positions of responsibility and trust in railway service in this country are honest and faithful, goes without saying; but integrity and industry are not sufficient: they should also, as aforesaid, be men of intelligence, and should possess not only a special knowledge of their own departments, but also an accurate understanding of related departments of the service. By intelligent direction of those under him a foreman may largely increase the efficiency of a score of workmen; and, on the other hand, by failure to comprehend the scientific principles involved in the work he superintends, he may cause constant loss or make destructive accidents possible.

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*It is a great misfortune to our railroad properties that their owners are not brought into contact with the staff and rank and file of their operative departments, so as to appreciate their value and deficiencies or their needs and aspirations. Says Mr. Kirkham, in his work on the Maintenance of Railways, p. 35:

"No one who is dependent upon the good will and fidelity of others for the maintenance of his interests can afford to shun their acquaintance or permit them to remain in ignorance of his good intentions towards them. On the contrary, his duty and interest alike demand that he should cultivate such relations with them as may be necessary to assure them of his constant and friendly regard and the beneficence of his purpose. When it is necessary that men should entrust the immediate and general management of their property to others they must do so unqualifiedly and heartily, but such delegation of power should never extend so far as to relinquish the right and duty of enquiry into the status of subordinate employes. The proprietor will ever consult his welfare by such manifestation of interest in his servants, and any general or prolonged neglect on his part to fulfill this cardinal duty of ownership will redound to his great and permanent injury. By many owners such manifestation of interest is thought to be subversive of discipline, and it is possible that they have been encouraged in this monstrous delusion. It is a sufficient answer to say that where the owner of a railroad cannot come in contact with his employes without jeopardizing the discipline of the organization, it ought not to require an outbreak among his servants, or the destruction of his property, to convince him that there was a radical defect somewhere in its method of administration. The discipline of an organization that is dependent upon terrorism, upon ostracising or sequestrating the employe, upon separating him from the acquaintance or sympathy of the owner, is manifestly a gross perversion of responsible methods of government, and wherever practised evinces mismanagement, and may be accepted as evidence of discontent and insubordination and outrageous disregard of the rights of owners by those who encourage or practice it. If the tendency of corporate history in the United States teaches one fact more clearly than another it is that the owners of such property will find it to their advantage to manifest immediate and personal concern in its affairs and in the affairs of those who operate it, lest their personality be lost and their property alienated or its value seriously impaired. The possession of property presupposes the duty of guardianship, including a paternal interest in those who operate it, and its preservation to the owner will ultimately depend upon the general and wise exercise of this duty."

THE VALUE OF THE SERVICES OF FOREMEN AND OTHER RAILWAY OFFICERS DEPENDENT UPON THEIR TRAINING.

And what is true of a foreman applies with greater force to his superior officers. Where is the intelligent railroad official who has failed to realize the many problems yet to be solved in the matter of railway operations and appliances, and who is not also conscions that, for the most part, railroad officers and operatives are much more likely to fail in appreciation of, and even to oppose, improvements and contrivances of merit in this field worked out by others, than to originate them?

TECHNICAL EXPERIENCE MUST BE SUPPLEMENTED BY GENERAL KNOWLEDGE.

The exigencies of railway service require men of special training, of peculiar qualifications, of minute practical knowledge. There are no important exceptions to this rule in any of the departments or branches of the business. To perform their duties wisely and efficiently supervisory officials must be relatively as well skilled as the general manager. They must possess a general knowledge of the branches of the service to which they are assigned, as well as a particular acquaintance with the peculiarities that are special to the immediate positions they hold. This general and particular knowledge involves an intimate acquaintance with the property, its defects, its resources and its peculiarities, and presupposes prolonged association and years of observation and thought, without which such knowledge is not attainable.

TESTIMONY OF MR. KIRKHAM AS TO THE UNRECORDED LOSS INCIDENT TO THE EMPLOYMENT OF NEW AND INEXPERIENCED OFFICERS.

In a recent work on "Railway Expenditures; Their Extent, Object and Economy" [p. 111], Mr. Marshall J. Kirkham says:

> Those not familiar with the practical operations of railroads can hardly estimate the innumerable mishaps and unrecorded losses that occur to a property in consequence of the introduction into its life of new and inexperienced officers,* of officers unacquainted with the duties they are to perform, unacquainted with the manner in which these duties have been performed in the past, or the scope and circumstances that are expected to characterize them in the future. The result is always disastrous, no matter how great the ability or how upright the intention of the new official. Under the most favorable circumstances he is placed in the position of a man called upon to act without possessing the definite and trustworthy knowledge necessary to enable him to act intelligently. He has everything to learn, from the arrangement of his files and office furniture to the unrecorded policy that has governed his predecessor He has to learn the local and foreign geography of the line, its peculiarities, traditions and prospects; what it possesses and what it does not possess; its contracts, agreements and leases; the officers and employes who operate it, and the people who give it support. All these things must be learned by rote before a new officer is either valuable or trustworthy. In the acquisition of his knowledge he is harassed by doubts, and his path is otherwise beset by obstacles.

THE B. & O. POLICY OF PRODUCING RAILWAY APPLIANCES FROM CRUDE MATERIAL.

I have already referred to the increasing tendency of railroad corporations to repair and even to manufacture their own plant. This seems to have been the traditional—as it is certainly the present—policy of the Baltimore & Ohio Company. It is patent that if everything, or most of the important things, needed in the operations of the service could be manufactured from the raw materials, in our own shops, by our own employes, of as good quality and character of construction as can be had elsewhere, and always with economy, the interests of our stockholders would dictate that policy.

NEED OF REFORM IN METHODS OF SHOP-WORK AND MANAGEMENT.

But, in order to produce in the shops of corporations of such extended and diversified interests as railroads, work of a high order, with economy, very material progress must be made over the situation as I now regard it. We have seen that no productive enterprise can in our day be made an economic and commercial success without intelligence and skill, and that, other things being equal, it will be profitable just in proportion to the degree in which those elements are utilized. Surely, enough has already been said to establish these two elements as of the highest importance in the production and in the operation of railway plant and appliances.

*And they never will be able to appreciate these mishaps and unrecorded losses, for the reason that it is the interest of the class who precipitate them to conceal the real facts from the owners of the property.

I presume no more difficulty is experienced in procuring for railway service men who have manual skill, and who are frequently superior artisans in their several occupations, than it is to obtain them for other pursuits; and I know that many railway shops contain many such men, whose worth as mechanics cannot be denied, and who have doubtless made the best of their opportunities.

THE DEMAND IS FOR SKILL COMBINED WITH GENERAL AND TECHNICAL KNOWLEDGE.

But the great want in railway service is men who combine technical skill with disciplined minds and broad intelligence; men who, with professional experience and knowledge, possess minds disciplined to accurate observation and logical thought—qualities that come from sustained mental application, and are not likely to exist without it; men whose qualifications make them worthy of promotion, and guarantee efficient and economical management. I cannot too often emphasize the statement that, to the extent such qualities are lacking in heads of departments, and *intelligent* service is lacking in the rank and file, railway operations will be conducted crudely, inefficiently and with high percentages of operating expenses to gross revenue.

SCARCITY OF EDUCATED TALENT IN R. R. SERVICE.

While this is so patent as to be undeniable, it is certainly a fact that we have not generally been successful in securing enough of educated skill and intelligence to even leaven the mass of "*practical*" men who constitute the operating forces—to say nothing of other departments—of our railways. Whether this be because the managers of railway interests are apprehensive of the disapproval of their stockholders if they pay more than the *lowest* market price for labor, or personally entertain too indifferent notions respecting educated talent to induce them to compete for it with private firms and local corporations that *do* value it at its commercial worth, is not for me to say; but I do assert that it is folly for such long-lived corporations as railroads to hazard their future prosperity for temporary profits, as they do when allowing and encouraging their administrative officers to seek and to prefer uneducated—because nominally cheap—labor. If we expect to operate such properties on business principles, and not for mere speculative results, our railway managers must provide for the better education of the rank and file of their employes.*

TYPES OF RAILWAY SERVANTS.

Historically considered, the first servant of a railroad in whom technical knowledge is an essential qualification is the locating, followed by the constructing, engineer. Our colleges and technological schools are yearly turning out, in increasing numbers, young mining, civil and mechanical engineers—the latter in less numbers than the wants of the country require. Electrical engineers and industrial chemists are also making their appearance, and as electricity, mechanically applied, is coming to the front as an important accessory of railway service, and will soon form an essential part of our transportation operations, this class of specialists ready made to our hands will, when competent, easily find lucrative employment, and it will be many years before they overstock the telegraph and railroad markets alone. The industrial chemist is also destined to play no insignificant part in the railway management of the future. But none (or at least very few) of the members of any of these, or, in fact, of any other classes, enter upon professional life understanding, or qualified to meet, the necessities of railway service.

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*The purchase of low-grade materials because they are cheap and can be made to serve present purposes is even a lesser evil than depending on low-grade labor. Parenthetically, a writer already quoted says:

"Only an experienced and farseeing manager, I have remarked, can withstand the seductive influence that envelops an article of prime necessity to his company when offered at a low rate. The fact that its ultimate cost will be out of all proportion to the temporary saving is lost sight of or ignored by some. The immediate and visible reduction in the cost of operating, and the notoriety that will attach to him for effecting such reduction, are too strong for a weak man to withstand. This would not be the case to the extent it is if so great a proportion of the loss which a company must ultimately suffer in consequence of the purchase of inferior material was not unavoidably blotted out or covered up under foreign headings, and remained, in consequence, unknown. . . . In considering the cost of car and locomotive wheels, axles, frames, springs, bolts, nuts, and kindred appliances, we find the relative cost between the good and the bad articles is not alone manifest in the price paid for the article itself. It will be discovered that the use of the inferior article materially swells the disbursement accounts for deaths and injuries from accidents, for losses and damages, and all the multitudinous expenditures enumerated above in connection with the use of inferior lubricants, including the cost of repairing tracks, torn up by derailed trains, the interruption of business and its manifold losses, the swelling of the account for wages, and finally the cost of repairing the injured equipment."

SCHOOLS NOT CONNECTED WITH WORKSHOPS CANNOT FURNISH THE KIND OF TRAINING THAT IS NEEDED IN RAILWAY SERVICE.

It might, indeed, with some reason be assumed that a competent *civil engineer*, at least, would be qualified to undertake *railway* engineering, but a railway engineer is not, to the present time, the creation of any educational institution in this country. Upon this single point, a paper just read before the Society of Arts of the Massachusetts Institute of Technology (one of the best conducted in the country) is exceedingly interesting, and I therefore append it hereto as Exhibit T; recommending it to your careful perusal. Much of what is therein said may be taken to apply with equal force to other branches of railway service, and it will well repay the reading.

COMPETENT MEN OF VARIED ATTAINMENTS A NECESSITY IN RAILWAY SERVICE.

In railway service, especially, there is frequent necessity for sending to a distance, and beyond supervision, one or more thoroughly competent men, who shall not be simply mechanics, in the ordinary acceptation of the term, but who shall be able to turn their attention to work coming under their notice, whether they have before done that thing or not.

YOUNG MEN OF INTELLIGENCE MAY BE ENTRUSTED WITH RESPONSIBLE DUTIES.

I think we are all prepared to admit that at present such men are rarely found enrolled in the rank and file of railway mechanical departments; yet it is testified by many manufacturers who have afforded their employes the advantages of technological instruction, that they have no difficulty in filling such positions with boys of 20 or 21 years of age, whom they send long distances and place in their hands work with which they have had little or no previous acquaintance, and by their intelligence they not only give the greatest satisfaction, but frequently develop into competent teachers of others.

Quite enough has been said in this report to show the necessity of technical knowledge on the part of machinists and other artisans employed in constructing and repairing railway equipment. As a class, the men thus employed are doubtless of average skill in their several trades, but it is apparent that in such a hard service as railroading, where machinery, rolling-stock and roadbed are, as a rule, taxed to their maximum strength and capacity, even a slight lack of appreciation, on the part of mechanics and those supervising them, of the special and technical requirements of their work will result in the failure of their productions at critical moments, always to the pecuniary loss of the owner and sometimes causing serious disasters.

NEED OF FLEXIBILITY IN WORKMEN.

Mechanical trades are at present acquired in this country through very general instruction or in shops devoted to special construction. When work is stagnant in one branch of a trade it is generally active in other directions, and the mechanic must, from necessity, often drift from that kind of work in which he is educated to others to which he can apply only manual skill, with a smattering of general knowledge, perhaps altogether inadequate to the proper performance of his new duty. Even our foremen, master mechanics and supervisors, who are, almost without exception, men of practical knowledge and long experience in their particular lines of work, have very seldom received such general or technical instruction as would enable them to appreciate the effect, upon their own productions, of changes in methods of operation such as are constantly occurring in all transportation service and to meet them.

EDUCATION OF ENGINEERS.

Every one understands why locomotive engineers should be well educated, and yet we know quite well that very few have enough education to enable them to respond to emergencies requiring higher qualities than mere mechanical skill, courage and local knowledge.* In our road departments very few foremen or super-

*Says Mr. Wm. Fairbairn, of Manchester, F. R. S., and an authority on the subject:
"The locomotive-engine drivers and stokers have only been known to us for the last twenty years, but they constitute at the present moment an important branch of the industrial community, and so far as their acquisition of knowledge and respectability of character are concerned, we are all, individuals as well as the public, deeply interested. Engine drivers and stokers, above all others, should have a regular and rigid course of training. They should have a keen eye and a clear perception; they should be taught care and attention to signals, and every minutia connected with the rules and

visors understand—or if they understand can intelligently describe—the causes which deteriorate their track or bridge structures, or otherwise affect their every-day work.*

I might in similar manner go over the whole list of railroad operatives, but it is unnecessary. The reason for all their educational deficiencies is apparent when we consider how few opportunities they have for acquiring theory and practice in the same place or at the same time during any period of their lives.

SKILL AND INTELLIGENCE DIVORCED BY PRESENT PUBLIC SCHOOL METHODS.

It has been shown that so wide is the chasm between our schools and our workshops that those in the one seldom pass directly into the other, and consequently manual skill and intelligence remain divorced. By means of workshop-schools, properly conducted, a railway company may not only obtain intelligent help cheaper than it could otherwise be secured, but it may also so shape the instruction herein as to exactly adapt it to the requirements of its service, and thus give it a pecial value not attainable elsewhere at any price.

ADVANTAGEOUS EFFECTS OF WORKSHOP SCHOOLS UPON RAILWAY INTERESTS.

Such schools also seem to offer the easiest and cheapest solution of the problem how to secure a corps of workmen and operatives combining technical skill and general intelligence in a high degree with that special acquaintance with the needs and details of operation so important in railway service.

Again, it is matter of common observation that our universities, colleges, academies and high schools turn out, in superabundance, young men possessing theoretical knowledge and dialectical skill in sufficiency, but who, lacking manual expertness and practical knowledge, are comparatively useless for industrial purposes.

CHARACTER AND DEGREE OF EFFICIENCY OF ACADEMIC GRADUATES IN RAILWAY SERVICE.

Similar complaint is also very generally made against all our technological schools—that their graduates are too theoretical and not sufficiently practical, and this must necessarily be so wherever such schools are unconnected with shops operated as *bona-fide* industrial enterprises. On the other hand, it is difficult to procure at any price men who combine superior skill, comprehensive mechanical knowledge and general intelligence in such proportions as to make them valuable as foremen, managers and specialists in mechanical pursuits or in the operating branches of railway service. An appreciation of this fact, and of the necessity for educating their workpeople to an understanding of modern railway machinery, appliances and methods, has led a number of managers to seek the services of the graduates of technical schools as assistant foremen, assistant supervisors, assistants

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government of the lines on which they are employed, and, above all, they should be instructed in the management of the engine, the value of time, and the absolute necessity of working the distance according to the time table and those established rules by which they and the public are to be governed in their departure from and arrival at the different stations. A driver should also be acquainted with the principles upon which the steam in the boiler is generated, its elastic force, the security and free working of the safety valves, and, in fact, in order to prepare him for public service, he should attain his degree and character in the Workingman's College before he is considered eligible to mount the foot-plate or to handle an engine. Lastly, other classes, such as blacksmiths, carpenters, masons, bricklayers, turners, tilers, moulders, etc., exclusive of innumerable others, such as spinners, weavers, dyers, printers, etc., employed in the manufacture, might each of them reasonably demand to be included in a national system of industrial education."

* In this connection the following is suggestive:

"The acquisition of knowledge, as every one has occasion to remark, is not of so much value for the specific thing that we learn as for its contingent revelations, the correlative ideas that it suggests; and so it may be possible that even an imperfect conception of the fixed expenses of a railroad may afford suggestion to those who are not disposed to regard the information itself of especial value. Thus, while we may not care what relation the fixed expenses bear to contingent outlay *as a whole*, if we knew accurately the effect of wear and tear of traffic upon particular classes of expenses, and the percentage of deterioration from natural causes, there can be no doubt that the knowledge would prove of value to particular men, if not to railway men as a whole. The truth of this bears apt illustration in the case of track-rails.

"Practical men with whom I have communicated as to the relative deterioration of rails from climate and traffic, have stated that a rail will remain fit for use forever if trains do not run over it; others put the deterioration from natural causes at two per cent.; others at five per cent., and so on. As a matter of fact, the deterioration of rails due to climate, while not great, is marked and cumulative. The deterioration from climate in the case of other materials is, as a rule, much greater. It is not necessary, nor would it be proper, here to enter into a minute or scientific statement of the effect of climate upon different classes of material. The subject belongs more properly to scientists. I merely cite the case of rails to illustrate the lack of information on such subjects by those whose duties are connected wholly with the care of such property."—[Marshall M. Kirkham, "Maintenance of Railways."]

to engineers of roadway, master mechanics, etc. After some actual experience these young men are put in line of promotion, and inquiry shows that generally they stand well in their respective corps, but even after going through the shops, such graduates continue more theoretical than practical, and this constitutes the great objection to railroads taking into service technological school graduates, instead of *educating* their own young men.

As already shown, combined mental and physical education alone give satisfactory results, and no substitute for this method will yield a railroad the highest value of its talent.*

POLICY OF PENNSYLVANIA R. R. IN EMPLOYING COLLEGE GRADUATES.

The Pennsylvania Railroad pursues the plan of exacting of the gradnates of technological institutions entering its service a novitiate in the construction and repair shops at Altoona before they are permitted to enter active service. Many young graduates of technical schools so highly value the opportunity of studying the scientific methods and enjoying the instruction of the Altoona shops as—it is said—to disregard pecuniary compensation, in a wise desire to avail of the fine training obtainable there. At the same time, if I am correctly informed, this instruction is neither so specific nor so thorongh as it should be, nor can any method by which it is sought to qualify yonng men as railroad officers be successful which does not provide for theoretical instruction in those branches of knowledge that comprise what may be designated as railroad science, *pari passu* with actual commercial shop-work; the latter illustrating and confirming the former.

THE METHOD NOW IN FORCE AT MT. CLARE FOR SECURING EDUCATED APPRENTICES.

This method of combining theory and practice so as to give both an educational value has during the past year been pursued with signal success in preparing the apprentices at Mt. Clare for cadetships in the B. & O. service, under the program announced in yonr circular of January 15, 1885. When it became publicly known that technological instruction had been inaugurated at Mt. Clare, we were besieged by applicants for admission to the school whose social status, scholarship and culture were infinitely superior to anything found among the 147 apprentices already in service, whom we had examined under the terms of that circular. Many of these young gentlemen entered as regular apprentices, without favorable discrimination as to hours of work or pay; in fact, they accepted low wages for services far more valuable to the company than those of the average uneducated apprentice. By supplementing their shop-work with the class-instruction which was specially adapted to it, they have achieved excellent records, and now possess a very solid foundation for a higher technical course, in which theoretical instruction may predominate, and after a year or two of fnrther study they will honor the service in whatsoever positions may be assigned them.

INTELLIGENT WORKMANSHIP WILL REDUCE ACCIDENTS.

With educated and intelligent workmen and operatives, railway companies will have fewer accidents, and the saving on this single acconnt would doubtless often more than cover the cost of a liberal edncational provision. Of the graduates of a technical school at Lille, M. Hovarez says: "Those engaged in working mines soon perceived that workmen who came from this school heated their boilers better and with less coal than did the other workmen, and that they escaped many accidents and repairs and stoppage of machinery." If this be true of simple stationary engines, how much greater mnst be the effect upon such complicated machinery as railroads operate! On this point Jndge McArthnr says that technical and scientific education becomes a subject of universal interest; that—

> The ordinary accidents to which we are exposed arise in too many instances from some error in the work of the draughtsman or the machinist. The unexpected fall of buildings, and their bad construction, as developed in cases of fire, are sometimes attended with horrors that curdle the blood and sweep away precious lives by the most excruciating deaths. The wheel or axle of the locomotive may be unsound in material or model, and the train in its rapid flight be plunged over a viaduct or embankment, bruising and maiming its living freight and sending our best and most beloved ones into the grave without warning or preparation. Boilers explode, machines are shattered, owing to defective work of some kind, and the newspapers publish a daily catalogue of disasters more appalling than the carnage of war. The lesser evils are also considerable.

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*Dr. Quincke, formerly Professor of Physics in the Berlin Polytechnic School, and now Professor of Physics at the University of Heidelberg, pointed out to the Royal Commissioners the error made by many in believing that any polytechnic course of instruction could *by itself* teach a student (for instance) to crect an engine, work a blast furnace, or manufacture sulphuric acid; the real object of a technical school being to facilitate the transition from pure science to practice by means of appropriate lectures and laboratory work, which are obviously insufficient to prepare the student for carrying on actual work where practical experience is needed.

UNEDUCATED WORKMEN UNABLE TO UTILIZE SCIENTIFIC DISCOVERIES AND METHODS.

Many of the discoveries of the day are not used because workmen do not understand them or are incompetent or unwilling to utilize them, and there is also an acknowledged deficiency in the ability of railroad employes to determine, with scientific accuracy, the shapes and dimensions which are best adapted to stand the strains of the various working parts of the locomotives and other machinery used by railroad companies. Though much has been done in this direction by specialists, it is more than probable, from their testimony and from the deficiencies of such machinery, that scarcely a tithe of the facts that may and ought to be known in this matter are yet discovered, or, where known, availed of.

INDUSTRIAL PROBLEMS MAY BE ECONOMICALLY SOLVED IN CONJUNCTION WITH SCHOOL WORK.

Such investigations, owing to the scarcity of men combining both practical and theoretical knowledge, are so costly and uncertain, and require so much skill and technical training to conduct them, that manufacturing companies cannot often afford to hire specialists or bear the expense of experimenting; but in a school connected with railway shops, under competent guidance and instructors of ability, much may be done, as a part of the school and shop-work instruction, that will, at the same time, accomplish desirable results in other fields. It is the testimony of many of our best educated engineers that the engineering profession in all its departments is continually hampered by the want of more extensive and more accurate experiments. They say that "in far too many matters they have nothing to rely on but the imperfect or imperfectly reported results of antiquated experiments." The difficulty is that most of their experiments and observations have necessarily to be of short duration, and that they have insufficient data upon which to base their conclusions. If, now, we can introduce the scientific method of original research and experiment into our workshops; if, instead of one experimenter, there may be dozens of wideawake, observing and energetic men in search of scientific and mechanical truth; if, instead of one experiment at a time, there may be several under different circumstances going on at the same time; if, instead of continuing a single day or a single week, these experiments in the workshop may be continued through months and even years; if, in other words, our workmen, or a large number of them, can be taught to regard the workshops themselves as great laboratories for continued research, experiment and observation with a view to gaining original information for practical purposes; then there need be no more complaint in the realm of applied science about inadequate data and uncertain conclusions.

But there are other important considerations which should induce railway managers to promote the education of their people. The advance of our civilization is seen in an awakened eagerness for scientific discoveries, and disposition to use scientific investigations, not alone as a method of mental gymnastics, but as a torch to illumine great fields of productive and commercial industries and to shed light upon the pathway of the laboring masses.

SCIENTIFIC INVESTIGATION OF INDUSTRIAL PROBLEMS PROFITABLE TO RAILWAYS.

What the outcome of this spirit of invention and discovery in the realm of applied science will be can only be conjectured, but whatever other industries may be affected by it, none are more likely to reap rich harvests from its encouragement and growth than those railroads that, in point of qualified managers, scientific specialists and intelligent and skilled workmen, are best prepared for promptly utilizing such developments. No industry has fixed boundaries, nor can any be said to have reached maturity. The inventions of to-morrow may necessitate radical changes in the processes and in the kind and manner of manipulating the machinery of to-day. We have seen how combined scientific and technical education conduces to economy and net results, by cultivating habits of thought and observation, and developing special aptitudes; thus enabling workmen to utilize improvements and inventions at large, and encouraging them in attempting inventions and seeking for more economical methods of work, which inure mainly to the benefit of the employer.

HOW IMPROVEMENTS IN MECHANICAL PROCESSES ARE ACHIEVED.

Original mechanical contrivances; new—and improvements in existing—processes and methods of manufacture, are seldom the result of accident or the fruit of a low degree of intelligence. Analysis of the history of industrial and mechanical progress demonstrates that the large majority of inventors who belonged to the artisan

class were deserving, faithful, investigating and generally well-educated men, whose minds, through technical training, had acquired flexibility, and whose faculties were stimulated by study. If *our* workmen do not make inventions and develop economical methods of labor, others in the employ of rival companies will do so, and the active competition of the age will give those corporations that are advanced enough to cultivate the intelligence of their employes material advantages over others. Even if, in order to neutralize this superiority, we are willing to pay well for the privilege of utilizing improvements and inventions owned by antagonistic interests, we may still lack the power, through want of intelligence and skill on the part of our own people. Because of the lack of scientific knowledge that would have enabled its managers to appreciate the value of a meritorious improvement, a railroad company with whose affairs you are familiar, now has to pay a rival corporation for the use of a slide-valve for its locomotives, invented a few years ago by one of that company's employes, who, for a nominal consideration, would have licensed it to manufacture this very valve for its own use and for sale to other companies.

PROFESSOR HUXLEY'S TESTIMONY AS TO DEPENDENCE OF INDUSTRY UPON EDUCATED KNOWLEDGE.

In this connection I again quote from Professor Huxley's declaration that "the advance of industry in all countries depends on employers being able to find to their hand persons of sufficient knowledge and sufficient flexibility of mind to be able to turn from the one thing they have been doing to something different, according to the nature of the improvement that has been made"; and that "the development of industry under its present conditions is almost entirely the result of the application of science to the development of mechanical processes of complexity, requiring a great deal of attention and intelligence to carry them out."

SO-CALLED PRACTICAL SKILL UNPROGRESSIVE AND NON-INVENTIVE.

In this connection, the citation of two curious circumstances, bearing on a branch of trade in which we are greatly concerned, will interest you. The iron and steel workers of Cheshire and Lancashire are the most skilled manipulators of the common metals in the United Kingdom, and their mechanical instinct has been hereditary for centuries. The first Earl of Chester was Master-of-Arms to William the Conqueror. His workmen resided in the villages of those counties, and when the use of armor was discontinued they were still notable workers in iron and steel. Their descendants still call their tools and implements by Norman-French names. *They possessed hereditary skill and knack such as no other workingmen in the Kingdom had; yet from all this body of skilled labor no inventions came;* they were and are satisfied to go on as their fathers and forefathers had done, and the inventions which have made this the age of steel came from those who were destitute of their practical skill. The introduction of the hot blast in the furnace; the application of the cold blast in the Bessemer converter, which changed liquid iron into steel; the production of steel direct from ore on the open hearth, and the discovery of the basic lining, by which phosphorus is eliminated and all grades of iron made convertible into steel, revolutionized the mechanic arts; and yet it is remarkable that only one of the inventors of these processes was directly connected with the iron trade, and not one came from all this body of workmen whose skill in manipulating iron had descended to them through many generations.

WHO ARE THE VALUABLE INVENTORS IN METALLURGY.

The hot blast was discovered accidentally by an engineer; Sir Henry Bessemer was an engraver; William Siemens was a mechanical engineer and electrician, unconnected with iron industries; Gilchrist Thomas was a member of the Civil Service; James Watt was an instrument maker; so that the iron and steel industry owes its development to science, distinct and apart from itself, and in no material degree to its rule-of-thumb workers.

DISADVANTAGE OF USING ANTIQUATED MACHINERY, AND CRUDE WORKMANSHIP IN RAILWAY SHOPS.

The rapid and important improvement of machinery and mechanical appliances has placed many of our older railway companies at a disadvantage, in respect to economical construction and repair, in that their shops are filled with machinery and appliances of obsolete patterns, costly and slow in action, while works more recently established are generally equipped with the latest and best the market affords. Mechanical processes enter so largely into railway operations, and the

results of using crude help or plant so directly and seriously affect the percentage of operating expense to gross receipts, that one unacquainted with the history of railway management would naturally, but vainly, look to railway shops for the latest improvements in processes and machinery there used; for probably few managers would have the temerity to propose the periodical replacement of obsolete for the latest approved practice and inventions in shop-work, though able to prove the wisdom and economy of such a procedure.

MOST WORKMEN IGNORANT OF NATURAL LAWS AND SCIENTIFIC METHODS.

I might almost indefinitely multiply testimony respecting the difference in efficiency and economy between educated and uneducated labor; but I apprehend it is only necessary to prompt the minds of those experienced in handling labor to the line of reflections above suggested, to lead them to convictions respecting the economy in time, material, supervision, and value of products turned out by educated help fully as strong and emphatic as those I have quoted. At least those employers and supervisors of labor who possess the kind of knowledge that can only be acquired from the combined reading of books and extended observation know that at the present time most workmen in America have little *general* intelligence and less *general* skill; that most of them see machinery in motion governed by laws of the existence and nature of which they are totally ignorant; that they see operations performed the nature and scope of which they are incapable of understanding; that they are accustomed to make parts of machinery which, together with other parts of machines made by other workmen, go to make up an organic whole, and yet neither know nor care to know how to put those parts together, nor how to operate them when combined. It is needless to comment upon the results of such ignorance, except to point out that, aggregated, it must entail enormous losses.*

CHEAPER TO EDUCATE APPRENTICES THAN TO PURCHASE SKILL AND INTELLIGENCE IN THE MARKET.

How best to remedy this condition of affairs is a problem of very serious import; but I have written this report in vain if it has not at least demonstrated that, if we are to continue manufacturing our own plant, it will be cheaper to manufacture also our own skilled artisans, mechanics and other operatives out of the crude materials which abound in the shape of applicants for apprenticeship, than bid for them in the market; especially as, thereby, we will secure a corps familiar with the needs of, and attached by various ties to, the service.

Let me here add a little to the testimony in the first section of this report as to what technological schools are capable of accomplishing, especially in aid of railway interests. I call your attention to the mass of evidence contained in the Exhibits to this report, and in further and effective support thereof I adduce the testimony of Mr. J. Scott Russell, the eminent English engineer and builder, and other intelligent directors of labor. Although a highly educated man and an able scientist, whose scholarship has received recognition from several of England's learned societies, Mr. Russell is not a mere theorist on questions relating to manufacturing and constructive industries. When a boy he served a regular apprenticeship at a mechanical trade, after which he long followed the business of practical engineering; gaining such prominence that the building of the famous GREAT EASTERN was entrusted to his superintendency. The testimony of a man who thus combines great intelligence and learning with experience in the workshop, in the art of originating, and in the supervision of workmen, ought to command careful consideration from those who are largely interested in enterprises requiring constructive and mechanical ability.

WHAT TECHNOLOGICAL SCHOOLS ACCOMPLISH. TESTIMONY OF J. SCOTT RUSSELL.

In his "Systematic Technical Education for the English People," a book published in 1869, Mr. Russell says:

> It seems to me almost an axiom that intelligent men must do better work than boors; that trained, skilled men must do better work than clumsy and awkward ones; and that the more any man knows

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* While labor with hand-tools and machines should be wisely blended, yet, since machinery has a constantly increasing share in the conversion of material into useful forms, the educated mechanic should know how to design, construct and assemble the parts of a machine, as well as how to make its product; and excellence in construction is to be sought as a most valuable factor in instruction.

The power of the engineer to decide upon general grounds the best form and material for a machine, and to calculate its parts, is vastly increased by blending with it the skill of the craftsman in manipulating the material, and the fact that the product is to be tested and used kindles interest in its manufacture and furnishes additional incentive to thoroughness and exactness. [Catalogue of Worcester Free Institute.]

of the objects and methods of his own work, and the work of all those who around him are engaged in co-operation, the more likely he is to do his own part well, so as to exactly fit into and form one with his neighbor's work. Thus I think that an intelligent community of workmen will get through their work quicker, will fit its parts more nicely, will finish off everything more sharply, will waste less material by trial and error, and so give higher value as well as quality and durability to all their work, than ignorant, unrefined, uneducated men.

Unhappily, mechanics, when taught to workingmen, is generally either taught superficially, unphilosophically, or with little or no reference to the business of their life. Economy of bodily strength, best ways of handling things, best ways of helping each other, best ways of carrying, lifting, shifting things—these are seldom taught. Some algebraical formula, or abstract geometrical diagram, is put before the poor mechanics and called science; as well call it magic!

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BEARING OF TECHNICAL TRAINING ON RAILWAY CONSTRUCTION.

I will now come to practical matters which show directly the results of technical education in the production of one of its chief objects—the creation of wealth. It is notorious that those foreign railways which have been made by the people themselves, in the educated countries of Germany and Switzerland, have been built far cheaper than those constructed by us in England; *it is known that they have been made by the pupils of the industrial schools and technical colleges* of those countries; and I know many of their distinguished men who take pride in saying that *they owe their positions entirely to their technical schools*. I find everywhere through their work *marks of that method, order, symmetry, and absence of waste* which arise from *plans well thought out, the judicious application of principles, conscientious parsimony, and a high feeling of professional responsibility*. In the accurate cutting of their slopes and embankments, in the careful design and thoughtful execution of their beautiful but economical stone masonry, in the self-denying economy of their large span bridges, the experienced traveler can read as he travels the work of a superiorly educated class of men; and when we come down to details, to the construction of permanent way, arrangement of signals, points and sidings, and the endless details of stations, we everywhere feel that we are in the hands of men who have spared no pains, and who have applied high professional skill to minute details. It is well known that many years before we could follow their example, the engineers of the German railways had introduced a system of constructing and uniting to each other the iron rails of the permanent way which made them cheaper, safer and more durable than those employed in England. * * * It is remarked by every traveler that the work of their railway stations is, when compared with ours, much more beautiful, convenient and fit, both within and without; the construction of their trains, the proportions of their carriages, the fitness, convenience, and comfort of their internal arrangements, all tell to the disadvantage of ours, and the only thing in which our railways excel theirs is in high speed. Theirs, on the other hand, are economical in capital and high in revenue.

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ECONOMIC VALUE TO EMPLOYERS AND TO SOCIETY OF EDUCATED WORKMEN.

To return to the mere vulgar usefulness of educated human beings. I will venture a remark from personal experience in my profession, which I trust may illustrate the vast importance to us of educating not only governors, or masters, but of extending a high scientific education and skilled technical training to the workingmen of all skilled occupations. It is this: The community at large are deprived of the use of enormous treasures in mechanical invention, and enormous progress in scientific arts, by the fact of the general want of education in those who practise them. It may not be known, but it is yet true, that the mechanical power employed in all our manufactures is infinitely more costly than it need be. It is equally true that some skilled men of such professions know thoroughly how to produce immense economy in the production and use of mechanical power, but that we dare not put the means into the hands of the uneducated masters under whose control they would be applied. I am not now speaking of a loss of five, ten, twenty, or thirty per cent.: I say that I know that *we are only utilizing one-tenth to one-twentieth of the power we employ and waste, and that an economy of one hundred, two hundred, three hundred. and four hundred per cent. is quite within our power so soon as a better informed, higher skilled, more perfectly trained class of men and masters shall arise*, who are fit to be trusted with the use of instruments and tools at present utterly beyond their comprehension, control or application to use. Special knowledge is not sufficient to produce even the best special results. The best workman is always the one who has a knowledge of tools and principles beyond the direct requirement of his work, whatever that may be. The best scientist is always the one who acquaints himself with other departments of science than the one to which he is specially devoted. The best artist is always the one who does not limit himself to his specialty, but studies the whole circle of art. This breadth of study and work gives a breadth of knowledge and training which decidedly strengthens a man for his specialty, be that however rude.

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I am continually asked why a man whose business it is to turn a furrow, dig a ditch, wheel a barrow, move bricks, saw trees, plane boards, quarry stones, get coals, or hammer hot iron, need know anything more than how to handle a spade, use his arms, or manipulate his hammer; and whether more knowledge than that would not spoil their minds and set them above their work.

THE EDUCATED MAN MAKES THE CHEAPEST AND BEST WORKMAN FOR THE MOST VULGAR PURSUITS.

To this I can answer that, taking the matter on the very lowest grounds, I never saw any kind of labor in which the man of greater intelligence could not do more work in shorter time, to better purpose, and with less waste, than the mere uneducated savage of civilized society. I have seen at the plough the clodhopper, little more intelligent than the well-fed brutes in front of him, let his clumsy plough wriggle on with small care how it went, and little thought as to how its work were done; and I have seen the skilled ploughman, with half the number of horses, and with no greater toil to them, cover double space on the same kind of land with clean, straight, even, well-finished work. The one knew all about the draft on his team, the strains on his harness, the adjustment and action of his plough, and felt at his fingers (instinct with intelligence) every variation of direction or force which indicated whether his own slight pressure on the plough-stilt should give it bias one way or the other. The one man avoids difficulty because he sees it beforehand; the other endures it because he is in the middle of it before he knows it, and so must go through it. The intelligent ditcher who lays out wisely his day's work before he puts a spade in the soil, has so forecast and arranged it that every bit of earth is moved out of its old place into its new the shortest way, over the least distance, with the least force. The skilled navvy can do double the work in the day of the equally stout but unskilled

rustic; and if this be the case in the lowest operations of moving earth, it needs no iteration on my part to show that in every succeeding stage of work—in getting stone or getting coal—even before we come to shaping, selecting, fitting, fixing and finishing articles of workmanship, the more intelligent and better trained man will use his mind to apply his strength and wield his tools so as to spare his strength and material either for himself or his master. Estimated, therefore, on the lowest scale of social value, education means economy, profit, absence of waste.

TESTIMONY OF JOHN NYSTROM ON TECHNICAL EDUCATION.

Mr. John W. Nystrom, at one time Acting Chief Engineer, U. S. Navy, who received his education in the Royal Technological Institute at Stockholm, in which theoretical training is supplemented by workshop and laboratory practice, in a report advocating a *Techno-Naval Academy*, says:

There is now a very distinct line drawn between scientific and practical men. The more we study and cultivate the branches separately, the more distinct will this line become and the less will they understand each other, and may ultimately fall into irreconcilable estrangement. The prejudice against science is in our day a very serious evil.

A blind man can walk on roads and streets, but when he finds an obstacle must stop; at a ditch he may tumble into it; he cannot turn from his accustomed track. Such is the case with many practical and otherwise most valuable men working without a knowledge of physical laws. In order to follow up the improvements of the age, the track pursued by our fathers must often be abandoned and a new one selected and surveyed for ourselves.

Without the application of science we go ahead without knowing where we are going. In verification of which we have many examples in engineering blunders, sometimes submitted to a committee of inquiry, which may result in the discharge of the engineer, accompanied by extravagant abuse of the department concerned, and the evil only temporarily remedied by substituting another, who will most likely not repeat the same blunders, but will do something worse. There is yet no attempt made to permanently remove these evils and secure success in our enterprises by proper institutions.

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At the present time scientific attainments and true practical knowledge are very little respected; physical laws established by the Creator of the universe are often derided as theoretical; ignorance has taken the lead, and rules in the ascendant, and often adopts that which is opposite alike to science, experience and common sense.

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We must in all ages and in all countries expect active and operative minds to come forward with ingenious contrivances, sometimes with wild ideas, ridiculous in design, and wrong in mechanical principles; but then it is the function of science and knowledge to step in and correct their aberrations, or, if necessary, to guard against or prevent their further introduction until developed to an educated design, which otherwise might lead to destruction of life and property.

On the other hand, most ingenious and valuable ideas are sometimes submitted to the opinion of scientific men with no practical knowledge, who may condemn them from an imperfect perception of their merit. It is only a knowledge of combined theory and practice that can accomplish justice in all cases.

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We have numerous examples in Europe, particularly in Russia, where engineers are educated to only scientific attainments, and who, when they enter a machine shop or engine room, are incompetent for the proper conception of work, but are, nevertheless, entrusted with responsible stations, where their practical achievements only lead to mischief.

Our experience throughout life teaches us that a practical man without science seldom makes such serious blunders as a scientific man without practice. The merit then of the *Techno-Naval Academy* would be in the education of engineers in the practice, and not with mere scientific precepts of professors.

The writer has often observed the career of students from colleges, and regrets to say that too few of them turn their attention to work. Those who have received scientific education generally prefer to become professors, scientific advocates, patent agents, lawyers, philosophical secretaries, etc., etc., while the practical operations of our workshops suffer in the extreme. Every once in a while we have a steam-boiler explosion, killing off a great number of men, with great destruction of property; we build vessels which will not float; are often disappointed in the performance of vessels and machinery; we waste great amounts of fuel, and we make extensive and costly experiments in steam engineering without consulting the physical laws involved in the operation.

In iron foundries castings are often made with too little metal, and sometimes too much; the hydrostatic action of the fluid cast iron in the mould is rarely understood; the laws of shrinkage, strain, direction of crystallization, and sinking in castings of irregular form, are not generally comprehended; and many defects of experience exist which often cause the loss of valuable castings, for want of applied science. When the casting turns out a failure, it is generally said that the foundry superintendent is not skillful, or has not experience enough, which often means that he has not made blunders enough to secure success.

The general impression about the business of moulding and casting, as well as all other branches of mechanic arts, is, as has been repeatedly told to the writer, namely, that "the profession cannot be brought within the scope of science, and must be learned by experience alone."

On the other hand, scientific men without technical education, entrusted with practical problems, are generally not familiar with important circumstances involved in the operation, which accordingly results in blunders; they are then derided as "scientific men."

ENGLAND UNABLE TO MAINTAIN HER INDUSTRIAL PRE-EMINENCE BY MANUAL SKILL OF HER WORKPEOPLE.

England has long had a large body of skilled workmen, by whose labor she has attained commercial and manufacturing pre-eminence. But mere "rule-of-thumb" work, without general intelligence and scientific knowledge, was insufficient to hold that pre-eminence, which has several times been in jeopardy, and is now maintained only through recognition of the fact that her laborers must be intelligent, and that

their technical and scientific education is a national work. In this connection I call your attention to the following and to other quotations in Exhibit M about the waste of material, etc., in construction, due to lack of educated labor.

In the report relative to technical education by the Schools Inquiry Commission of 2d July, 1867, Mr. McConnell, one of the English jurors, is quoted as saying:

In the class for which I was juror for England, I made a very careful examination and comparison of our locomotives, engines, carriages, railway machinery, apparatus and material with those exhibited by France, Germany and Belgium (which governments support schools of technology). I am firmly convinced that our former superiority, either in material or workmanship, no longer exists. . . . Unless we adopt a system of technical education for our workmen in this country, we shall soon not even hold our own in cheapness.

TRAINED SPECIALISTS IN INDUSTRIAL ESTABLISHMENTS OF EUROPE.

The Royal Commissioners make frequent mention of the fact that in the most enterprising and successful factories and shops of Europe they found men peculiarly fitted and trained for their special duties placed at the head of the various departments and shops as managers and foremen. But they particularly noticed that very many of these firms had been compelled to make provision for the training of their own managers and foremen, so as to secure men specially adapted to their particular industries.*

In his testimony before our Senate Committee on Education and Labor (Exhibit R), Mr. Mather said that, as the result of the long and thorough study of our institutions which he had made preparatory to reporting to the Royal Commissioners on the industrial and educational facilities of the United States, he had recognized the "native ingenuity" of Americans in contriving helpful devices in various industries, and particularly in matters of transportation; but he had also seen that, notwithstanding their enterprise and ingenuity, Americans owed much of their rapid advance to technically educated Europeans, and that in so far as their achievements are the result of native efforts, it is due to lately established technical schools. I quote his language on this point:

MR. MATHER'S TESTIMONY ON INDUSTRIAL EDUCATION BEFORE U. S. SENATE COMMITTEE ON LABOR.

The workmen of America have been educated and brought up under conditions different from those prevailing in Europe. It is impossible to traverse this vast continent (America) without witnessing the evidence of originality of application and of a growing development due to education in the scientific arts. In the railroad system, from the locomotive to the baggage car, there are original design and naked ingenuity in every contrivance; in bridge-building, great daring and ready devices for temporary, yet safe, structures; in the navigation of rivers there are boats which differ from all European systems. The shallow rivers like the Mississippi, in summer, are navigated for thousands of miles by steamers drawing less than twelve inches of water. The Ohio conveys thousands of tons of material from Pittsburgh by boats drawing nine inches of water. Towns like Chicago, Denver and San Francisco were built under difficulties which require an entire departure from all old methods of applying science. The produce of the great agricultural regions suggested new methods of tilling, sowing and reaping, and in agricultural machinery the Americans showed how quickly and directly science could deal with vast products, which would rot in the field but for mechanical skill to preserve them. The same aptitude that dealt with the overwhelming abundance of the West has turned to account the sterility of the East, where in Maine, New Hampshire and Vermont the mechanical skill of the farmer in devising economy has contributed as much to his support as his knowledge of cattle and crops.

It is, of course, in the more recent structures and modern mechanical appliances that the evidence of scientific truths and methods is observable. The rough-and-ready contrivances of early railroad development indicate originality and "mother wit," but in the waste of material and crudeness of design may be noticed the absence of technical or scientific training on the part of those who conducted extensive engineering and mechanical operations in those days. The gradual diffusion of science is very marked in the rapid reconstruction, during recent years, of the great railroads of the past, and in the new main lines. Also in railway plant generally, the old is being replaced by the new, and the latter exhibits high theoretical knowledge combined with practical ingenuity.

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*It will be noted that the British Commissioners' report expresses astonishment at the great progress on the Continent of industrial methods and the successful application of scientific principles to manufacture since the Paris International Exhibition in 1878. [Second Report, Vol. I, p. 505, *et seq.*] They say that the great industrial establishments are almost perfect in their management and efficiency of production, especially in France, in Germany, in Belgium and in Switzerland, the countries where technical education has been most effectually tried and adopted. In 1878 the English nation was conceded to be far ahead of these countries in the production and manipulation of machinery, but the Commissioners now admit that much machinery of all kinds is produced abroad equal in finish and efficiency to that of England, and that it is applied to manufactures with great skill and intelligence.

When we remember that England has heretofore taken the lead in European manufactures; that she has decided advantage over her Continental rivals in the abundance of crude materials and cheapness of fuel; that heretofore her machinery has been acknowledged to be far superior to that used in the factories of other European countries; that the concessions above referred to are made and published to the world by a commission consisting of English manufacturers, legislators and educators; and when we consider further that not until very recently has England done anything worthy of mention for the education of her artisan class, while Continental nations have made strenuous efforts to this end through the establishment and munificent endowment of polytechnic and other industrial schools, the economic value and great importance of technical education appear in a most striking light.

The Americans undoubtedly owe to many European engineers the rapid advance they have been able to make in their public works. The conservation of water power for the use of the mills at Lowell and Lawrence, in Massachusetts, is due to the eminent hydraulic engineer, Mr. Frances, an Englishman who practiced for forty years in America, and who is deservedly esteemed as the highest authority on hydraulic engineering in America. Although a lucrative field was, in the early days, open to European engineers and machinists having a thorough scientific knowledge of their profession, yet it is evident that they soon found apt scholars in America, who, as they acquired some theoretical science, launched out into new paths, untrammeled by the traditions of older countries.

Even the science of foreigners, when applied here, takes different methods. The Englishmen and Germans become bold and self-confident to a degree only manifested by rare men in Europe. The everlasting thirst for *something new* excites, stimulates and drives men to venture into untrodden paths of applying their knowledge.

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All these evidences of scientific skill (in America) speak well for the methods of education in the recent past, so far as it goes, but other influences, such as "necessity the mother of invention," and the presence in America of foreign experts, will account for much of the rapid growth in the mechanical arts. The future development will depend upon a population not compelled to dare and endure and experimentalize for "very life." In the past the waste of material has been excessive. To make the best use of a given quantity of material requires a sound knowledge of its properties and of its disposal in the arts and manufactures by scientific methods. In this direction the technical and science schools already instituted have accomplished much in providing foremen and managers, chemists, miners and intelligent employes in the engineering and manufacturing products. (For schools referred to see Exhibit L.)

It is remarkable, however, that in the great centres of the mining and iron-producing districts, where so large an amount of mechanical construction is carried on, as, for instance, in Pittsburg, Chicago, Detroit, Cleveland and Philadelphia, so little has been done by the owners of large establishments, or by the town or State authorities, in the direction of technical schools, or evening science schools. These industries represent a large proportion of the working population in those large cities, and yet the owners of works have to rely upon the scientific knowledge obtained through many institutions remote from these districts.

Mr. Mather is only one of many who have seen and regretted—and have called attention to—the lavish waste of material and reckless expenditure of time and money, and even sacrifice of human life, that have resulted from our lack of scientific knowledge and failure to appreciate the economy of its application to productive industries. The facts cited in his report form an eloquent appeal for its greater application to our arts and manufactures.

Elementary knowledge is most easily, economically and thoroughly acquired in youth, when the mind is free from cares and distractions inseparable from manhood. Upon this point Mr. John B. Jervis, a civil engineer, who has lately written on the construction and management of railroads, well says:

ELEMENTARY KNOWLEDGE ECONOMICALLY ACQUIRED ONLY IN YOUTH.

Though there are exceptions, it is a general truth that it is expensive to learn a new occupation in maturer manhood; and consequently, the railway company that commit their business to unskilled or uneducated men, must be at the expense of educating them during their supervision of business, and while they are learning its arts and duties; meanwhile depending on advice, trusting to the guidance of others as they may chance to find out matters beyond their powers of criticism. Can there be a doubt that the proceedings of the pupil will often be undecided, wavering, and wanting in that system indispensable to the efficient and successful conduct of intricate and important business? Now, it has happened that such men have in some cases eventually acquired a good knowledge of business, but it is obvious that this education has been of the most expensive kind, and, what is particularly important, it has been at the expense of the proprietors, who paid a salary while the incumbent was obtaining the qualifications that would enable him to earn it.

It will be admitted that training of some sort is necessary for every department of labor or business. A man who is educated to a particular business—whose time is devoted to a full understanding of its requirements—and who is stimulated by the consideration of professional reputation, is more likely to conduct affairs advantageously than one who picks up his ideas at random, and though doing some things very well, will often fail in respect to others. Certainly the important matter of maintaining the track and machinery of a railway should be committed to the most competent hands.

CAPACITY OF TECHNOLOGICAL SCHOOL GRADUATES FOR WORK.

I also repeat that it is the universal testimony of employers that the graduates of good technological schools have a greater capacity for work than other workmen of average intelligence, and that they easily adapt themselves to changes of employment, oftentimes to the great financial advantage of their masters.

It has already been shown that many manufacturing companies in Europe have recognized the importance of affording technical training to their employes, and I have also called your attention to many workshop schools in various parts of Europe that are wholly or partly supported by proprietors.

RECOGNITION BY EUROPEAN EMPLOYERS OF THE VALUE OF SPECIAL TECHNICAL TRAINING.

So valuable is such previous technical training recognized to be, that I have learned of a large number of instances where employers are in the habit of sending to home and foreign exhibitions, at their own expense, those of their young people most advanced in technological study and of quickest perceptions, in order

that they may study new inventions, machinery, etc.; while many others allow their apprentices and young men to leave their work an hour or more before stopping-time, on class-nights, without abatement of their wages. Many European manufacturers and the managers of some foreign railway works now call the particular attention of their workmen to new designs, improvements in machinery and methods of work, and to successful inventions that have been made by other workmen trained in technical schools.

INTELLIGENCE AND THE LOVE OF INVESTIGATION PROFITABLE TO EMPLOYERS.

Such workmen, partly as a result of greater intelligence, recognize and are stimulated by the great possibilities that are constantly opening up to them, and partly through a love of study and investigation acquired in technological schools are constantly on the alert for opportunities to accomplish something above the performance of mere routine duty; whereas, lacking scientific knowledge and technical training, they would probably not only have contentedly followed in the footsteps of their predecessors, willing subjects to the tyranny of routine, but would, in all probability, have opposed the introduction of improvements made or suggested by others.

FURTHER ENGLISH TESTIMONY OF THE VALUE OF WORK-SHOP SCHOOLS.

Valuable information in the same strain is furnished by a number of the leading manufacturers of England, who state that, as one beneficial result of the instruction given their employes in classes and evening schools, they have perceptibly advanced in intelligence and, understanding better the directions given them, and the objects had in view in the work assigned them, their usefulness and value have been materially increased. That whereas, before they received a technical training, their workmen would have to return to the shops to get personal instructions on every emergency or case of difficulty, the same workmen, after acquiring the ability to make sketches and to reason about their work, now make suggestions themselves and remedy such difficulties without delay; also, that instead of requiring a draughtsman or foreman to look after every separate shop, the young fellows who are growing up under their system of technical instruction are making their own drawings, working from them, fitting their work together and erecting it with great economy, because one man now does what it used to require a separate man in each department to accomplish; and, generally, that their workmen are, at a much earlier date than formerly, acquiring intelligence and ability to understand and to execute their tasks, and at much less cost to the manufacturer. [Royal Commission, Second Report, Vol. II, p. 430; Vol. III, pp. 217-18.]

EDUCATIONAL AND MECHANICAL VALUE OF DRAWING.

One of the most valuable and effective agencies for increasing the intelligence and efficiency of workmen is instruction in drawing. The habit of working from drawings and from careful measurements; the ability to make drawings and to construct machinery and other products according to scale (which may readily be acquired in a school of technology by any one of ordinary intelligence) will always be a source of profit and economy to employers, and is probably of greater importance in railroad shops than in any other branch of industry. Very few of our artisans (and in this general term are included carpenters, shipbuilders, masons, machinists, etc.) know enough of the principles of projection to be able to read the working drawings placed in their hands, to say nothing of the skill required to make such drawings, and are therefore obliged to work under constant supervision and at reduced wages. While in some few cities drawing is taught in the common schools, it is an exceptional case where enough of the theory and application of projection is taught to meet this universal want of artisans; while, as a matter of fact, no school-child of either sex can well afford to dispense with the peculiar discipline which is derived from instrumental drawing and free-hand practice. A finished draughtsman must, for many years to come, be the production of special schools. Professor Thompson, of the Worcester School of Technology, says that—

> A boy who spends two hours a week in drawing and the rest of the time in working at the bench, learns his business faster and becomes more skillful in it than one who works all the time, and he calculates that the productive efficiency of every machine-shop would be increased thirty-three per cent. if every journeyman could read any common drawing and work by it.

Professor Ware, of the Boston Institute of Technology, says:

> Drawing is an invaluable element in a general education. To the workman it is of the greatest practical use. It makes him more intelligent and serviceable. If he attains to real skill in the use of his pencil, and develops the tastes and talents that cannot without this training be either discovered or made use of, he becomes a valuable person at once. Every branch of our manufactures is suffering from the want of just this intelligence and skill.

LABOR TROUBLES LARGELY ATTRIBUTABLE TO IGNORANCE.

That technological schools adapted to the wants and standard of our workmen will do much to prevent and overcome labor troubles, is self-evident. Such troubles frequently occur through the inability of the workmen to understand the mutual relations existing between labor and capital. Dense ignorance makes men the easy and ready tools of demagogues, while the influence of a few well-educated, thinking mechanics, scattered among a mass of workmen, is an invaluable nervine in labor agitations.

That such training as is here advocated will also be a source of profit to railway corporations, by diminishing the tendency to dissipation on the part of workmen, and thus increasing their efficiency in the shops and on the line, is easily demonstrable.

IGNORANCE THE PROLIFIC SOURCE OF MANY VICES.

It is not putting it too strong to say that ignorance is the great centre from which radiate intemperance, coarseness, brutality, vice, conceit, arrogance, irregular habits, and almost every other trait of character that a good workman should *not* possess. An ignorant and unskilled workman can never be anything more than "a hand," often untrustworthy and troublesome to his employers and to the community in which he lives, while an educated laborer is a valuable citizen in any community, and likely to be the helpful adviser of those availing of his services. In both Europe and America many promising enterprises are rendered unprofitable by the bad characteristics of employes, and capitalists abroad are beginning to see that the surest remedy for this evil is the education of the laboring classes. In Chemnitz, Saxony, one of the greatest centres of European industry, where the standard of education among all classes, including the poorest, is exceptionally high, there is a corresponding high standard of decency and self-respect among the laborers. Very little time is wasted through intemperance, and the workmen attend their tasks with great regularity. (Royal Commission, Vol. I, p. 304.) The same kind of testimony comes from Windisch, Switzerland, and from many other places, where the employers look after the education of their laborers. It is claimed that in Windisch dissipation is not known to the managers of shops. (Vol. I, p. 273.)

Mr. William Anderson, a member of the Institute of Civil Engineers, and also of the Institute of Mechanical Engineers, says:

> When we established works in 1864, we used to have great difficulty as regards the drinking habits of the people, and we had great difficulty in managing them generally. Monday was a blank day, for instance; but that is completely changed now, since the establishment of schools. The young men now engaged in the works, who have passed through the schools, are of a very different character from those we used to have. Instead of having letters from our men that we can hardly decipher, we get well-written letters, sensible in every way; and this improvement in elementary education has improved the whole moral tone of the class from which our workmen are derived. We are getting a better raw material to deal with, and the young men are beginning to show a desire for self-culture and self-improvement.

IGNORANCE ENCOURAGES DISSIPATION IN WORKMEN.

It is not surprising that men whose intelligence is so little developed that they have no source of pleasure or enjoyment within themselves, should easily acquire habits of dissipation. The workman who is incapable of deriving enjoyment from useful reading and elevating thought; whose home is probably nothing more than a place to eat and sleep in, possessing none of the comforts and social attractions that emanate from culture, and whose associates are not of a type calculated to elevate or inspire him with aspirations to do something and be somebody, is handicapped in the march of morality and civilization, and naturally falls an easy victim to habits of vice and dissipation.

DISSIPATION DISQUALIFIES FOR GOOD WORK.

It is the universal testimony of managers of labor that the usefulness of workmen diminishes in proportion to the frequency with which they spend their evenings in places of dissipation. This is natural, for after a night or even an evening spent in such haunts, a workman must resume his work dissatisfied with himself and with his surrounding; his brain will be dull, his hand unsteady. He will be irritable and unwilling to receive instruction or advice; indifferent as to how he does his work, or, if he can escape the penalty, if he does it at all. Of course I do not mean to intimate that all ignorant laborers are dissipated or predisposed by ignorance to vice, but it is an established fact that the mass of people who are vicious and dissipated are, if not wholly without mental training, mentally and physically unskillful, and that an educated man is not nearly so apt to indulge in dissipation as an uneducated one.

CULTURE GUARANTEES FIDELITY AND ENHANCES A WORKMAN'S USEFULNESS.

A man whose mind has been cultivated as his hands become skillful, finds enjoyment in his work; pleasure and profit in reading useful books and papers, and in innocent social pleasure of a higher type than can be found in bar-rooms or on the street-corners. His home, however humble it may be, is likely to be tidy, and to afford him an appreciable degree of comfort and enjoyment. Such a man is free from many temptations, and the probabilities are strongly in favor of his leading a sober and useful life; which, of itself, is a guarantee of fidelity to his employer. Instead of diminishing his ability for efficient work he will, in all probability, when out of the shop, bestir himself in acquiring useful information and in taking that rest which nature demands, and which will enable him to resume his duties with efficiency and satisfaction to himself and to his employers. It follows, therefore, from this point of view alone, that the necessary result of educating laborers will be increased profit to the capitalist and the elevation and greater remuneration of the laboring classes.

THE ADVANTAGES OF TRADE SCHOOLS IN EDUCATING AND PRESERVING THE MORALITY OF APPRENTICES.

Trade schools, by providing useful and congenial employment for the leisure time of apprentices, have an especially beneficial effect upon their future; keeping them from idleness and dissipation; increasing their self-respect and moral tone and confirming them in studious and steady habits at a critical period of their lives. One of the greatest advantages that comes from operating evening schools, or classes that require evening preparation of lessons, in connection with shops employing many apprentices, is that such schools fix the knowledge and continue the habits of thought and mental application acquired in school-life, at a time when all previous school-acquired learning would otherwise become so indistinct as to exert little if any influence in forming or confirming in them tastes for useful work and enjoyment.

Says Mr. J. Scott Russell:

> I am hopeless in the matter of educating the "workingman" who has grown up into manhood without education. For the most part, such men are too old to learn. I have never seen, but exceptionally, much good come of trying to drive figures and geometrical problems, and mechanical theorems, and light and shade, into the head of a full-grown workman who had failed to get a good education when young. There have been brilliant exceptions—how brilliant! how few!

I also quote again from Mr. Nystrom:

> It is not expected, neither is it necessary, that the student shall become an accomplished mechanic, but the object is to concentrate his mind on the work about which he is studying and calculating. When confined only to books and blackboards, his conceptions rarely extend any further. He acquires the knowledge by routine, as it were; the study becomes tedious to him; and when brought to bear on practice, the most simple problem may confound him. When a student is brought up in the combined science and practice, however, he generally acquires a taste for work—good workmanship and proper proportions—and the application of his science becomes a pleasure. He studies mathematics at the same time he learns drawing; physics and mechanics at the same time he makes his tools and models for machinery. His science is applied as fast as it is acquired, and he will never forget it. When a student is thus equipped for the journey of life, he is able to bring such physical laws into action as to secure success in all his enterprises. He will be able to record and report back to the institute his future experience, by which the most thorough connection may be kept up between science and practice
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> As things now stand, a man of most valuable information is not able thus to record his achievements; in fact, he may not know himself the very laws of his success; his experience and valuable knowledge die with him; his toiling successor will reiterate his blunders, and gain new experience by a new series of expensive trials and errors.

TRADE SCHOOLS MAKE THEORETICAL INSTRUCTION OF PRACTICAL UTILITY.

There are many other advantages that workshop schools have over others. Easy access to machinery, and the direct application of principles and theory learned in the school-room to work in the shops having a commercial value, would make such instruction practical in a high degree, while the tendency of the usual technological schools which use mechanical plant (generally limited in quantity) for illustration and manual exercise only, is toward the study of science, without regard to its practical application.* Workshop schools would also make it possible to bring

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*The great difficulty I experienced in getting tangible and conclusive evidence of the utility of workshop schools abroad arose from the *degeneration* of their original programs into purely theoretical instruction and the teaching of principles without applying them. I know of but one English school where any consistent efforts are made to apply school instruction in the shops—that of Mather & Platt, Manchester, whose teachers are employed in the shops and personally direct the theoretical instruction of their pupils to shop-work. The absence of this combination of theory and practice,

science to bear upon mechanical pursuits in a way and with a power that has heretofore been impracticable, because thereby it is possible to have long-continued, closely inspected and carefully verified experiments bearing directly upon practical work. So great has the demand for learning become, and so numerous and diversified the occupations of life, that to be successful it is now necessary for men and women to specialize and expend their intellectual energies in particular fields of thought and investigation.

TECHNICAL EDUCATION MUST BE SPECIALIZED.

In accordance with the principle of economy from division of labor, it is necessary that the same degree of specialization shall be applied to technical education. But no school, as such, can accomplish what is needed in this direction that does not afford opportunity for practically applying the knowledge gained in class instruction, and the only way to accomplish this is to have schools intimately connected with, and under the management of, industrial corporations.*

TRADE SCHOOLS ENABLE THE YOUNG TO EARN THEIR LIVELIHOOD WHILE BEING EDUCATED.

Trade schools are especially valuable for training the young of our industrial classes, because they are thereby enabled to earn a livelihood while acquiring theoretical and practical knowledge, *pari passu;* each supplementing and assisting the other. As no boy can well acquire the manual skill of a good workman except in the workshop (or in the field, so to speak), where all the details and appliances of a trade are regularly used, and where the methods and processes of that trade are to be seen on a business scale, so no boy can well acquire the theoretical knowledge pertaining to a trade where his attention is constantly distracted by material sights and sounds, more attractive to the young than mental application. We all know that scientific principles are easiest fixed in the mind in youth, and by the illustration and practice of rules in actual work, to which the responsibility of value attaches. When a boy can be got to comprehend the elementary principles of a science, he has put himself in the way of mastering that science in after years. But before he can make any solid advance in scientific knowledge, he must have a basic education such, for instance, as should be furnished by our grammar and higher public schools.†

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under intelligent direction, constitutes the great weakness and seriously impairs the usefulness of such schools. To teach the principles of mathematics, physics, mechanics, machine construction and gearing, the formulæ of chemistry, etc., without fixing those principles in the scholar's mind by illustrative experiments, the actual handling of apparatus, machinery and tools, is an impractical method of instruction which, as aforesaid, has in a large measure destroyed the usefulness of technological as well as of public schools.

*In the October *Century*, President Gilman, of the Hopkins University, places himself on record in favor of industrial education, and formulates his views of what may be done for its promotion in our educational institutions of every grade. Doubtless Baltimore would receive wise counsel and substantial aid from him and his experienced coadjutors in remodeling our school system so as to make it more nearly conform to the recognized needs of the city and age. The Guilds of London afford valuable precedents and a wide experience upon which to found an intelligent and practical scheme of trade education; and should the city show such a spirit of advancement, the Johns Hopkins University might be disposed to supplement it with a school of applied science similar to those of Harvard or—better, because more practical—of Cornell or Columbia.

†He who has studied, reflected, learned and arranged his knowledge in system and order, is able to gather other stores of knowledge and add them to those already acquired. In order to knowledge, therefore, reflection is indispensable.

The reflective faculties, we see, are eminently practical. They are not so much for speculation as for life. Not even the simplest work can be well done without them. The chief difference in all workingmen is that some put their brains into what they do, others do not. It is so with woman's work, too—with sewing, housekeeping, cooking. How invaluable is thought in all this, and, alas! how rare. That is why we say, "Let boys and girls in our schools be taught to think; let them not be drilled so much in remembering as in reflecting; lay more stress on processes than on results." There is an objection often urged against these higher reflective faculties in their exercise for common objects—that they give theoretical rules which are not practical. Thus, if one not actually engaged in teaching suggests any new view intended to improve the processes of education, he is apt to be told that this is not "practical." It is sometimes even assumed that theory and practice are opposed to each other. We often hear it asserted that a notion may be "true in theory, but false in practice;" that is, useless for practical purposes. I, for one, esteem practice. I trace all real knowledge to experience. I care for no theories, no systems, no generalizations, which do not spring from life and return to it again. Practice and theory must go together. Theory, without practice to test it, to verify it, to correct it, is idle speculation; but practice without theory to animate it is mere mechanism. In every art and business, theory is the soul and practice the body. The soul without a body in which to dwell is indeed only a ghost, but the body without a soul is only a corpse. When the waterworks in my house get out of order I want a theoretical plumber as well as one who is practical. I want a man who understands the theory of hydrostatic pressure; who knows the laws giving resisting qualities to lead, iron, zinc and copper; who can so arrange and plan beforehand the order of pipes that he shall accomplish the result aimed at with the smallest amount of piping, the least exposure to frost, the least danger of leakage or breakage; and this a merely practical man, a man of routine, cannot do. The merest artisan needs to theorize—*i. e.* to think—to think beforehand, to foresee; and that must be done by the aid of general principles, by the knowledge of laws. An intelligent man, a man of general culture,

WISDOM OF REQUIRING OF APPLICANTS FOR APPRENTICESHIP A HIGH STANDARD OF QUALIFICATIONS.

Even where it is not deemed wise to inaugurate workshop schools, as such, much can be done by managers of railroads towards securing higher grades of apprentices and helpers, by fixing a proper standard of qualifications, to which all boys applying for service must, as a condition precedent to appointment, demonstrate they have attained, and then requiring them to attend evening-class instruction of a technical character, which can be maintained at trifling cost, or even to attend public evening schools. The good effects that have followed such a procedure have been shown in preceding pages. Mr. Thomas Clegg, of Manchester, testifies in the same strain:

I have, from quite a boy, attended and taught night schools, and seen a good deal both of the working and results of them, and believe my convictions have arisen partly from this, and in a great measure also from being a considerable employer of workpeople; from fifteen years of age probably never having fewer than one hundred under my individual management. My two brothers and myself have now probably not less than from 1,200 to 1,500 people in our employ. I have always maintained against all my friends that those parties that have been educated in the schools that I have been connected with will always do *more work* fo. the *same money* and *do it better* and *with less trouble* than those that are not educated; and I have always been in a position to prove it so.

EXAMINATION OF APPLICANTS FOR APPRENTICESHIP IN B. & O. SERVICE.

The system of examination of applicants for apprenticeship inaugurated by the Baltimore and Ohio Company nearly two years ago, was regarded as a hardship by many people, and especially those who had uneducated sons they wished admitted to the Mt. Clare shops. They did not consider that with lack of intelligence is always combined an absence of ambition on the part of a boy to make anything more than an ordinary mechanic of himself; that much more time is necessarily consumed in teaching a trade to an uneducated boy than to an educated one; that the former is not nearly so useful during apprenticeship as the latter, and that when he has acquired the manual skill of his trade, the uneducated workman will still be the less useful of the two, because lacking those valuable habits of careful observation and systematic thought that result from scholastic training, and are hardly ever otherwise acquired.

COMPULSORY INSTRUCTION OF APPRENTICES IN B. & O. SERVICE.

Upon the inauguration of compulsory class instruction at Mt. Clare, the same sort of protest was freely indulged in by opponents of the measure, who argued that corporations have no right to compel their apprentices to attend evening school after a day's work, and that anyhow the results of compulsory attendance would be disappointing; for although boys might arbitrarily be compelled to attend evening classes, they could not be made to learn against their will. The answer was made to such arguments that it is a common practice with firms and corporations elsewhere to compel the attendance of their apprentices at evening schools; that where applicants for apprenticeship understand this to be a condition precedent to their employment and yet accept it, there can be no injustice in enforcing the rule; that experience has shown that though boys may at first attend class instruction reluctantly, they usually soon become interested in their studies and unwilling to give them up, and that those who obstinately refuse to learn always turn out to be poor workmen, whose services are unprofitable and should, in the interest of the service, be dispensed with. The results of class instruction at Mt. Clare have abundantly demonstrated the correctness of this position.

INFLUENCE OF SKILLED AND EDUCATED WORKMEN UPON OTHER WORKMEN.

It may with much reason be expected that the good resulting from workshop schools will not be wholly confined to their pupils, but that their influence will extend to the journeymen and others with whom the students associate. The edu-

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whose mind has been quickened with ideas, will often be able to show a mechanic how to do his own work. When we are young we have a superstitious faith in the knowledge each man is supposed to have of his own business. We outgrow this after a while. If you wish anything done about your house, send for a mechanic; but overlook him: do not leave him to himself. You will presently find that you can suggest something to him in his own work which he has never thought of. All success depends on practice, but all improvement on theory. Let neither despise the other. The saying that anything "is true in theory, but false in practice," involves an impossibility. The theory indeed may be plausible, but false, and then it will not work, and its not working is the proof of its being false. It is neither true in theory nor in practice. On the other hand, a theory which is true may not work at first, because the true way of working it has not been found out. It is not false in practice, but practice has failed at first; but you cannot say they were "true in theory, but false in practice." They had not been really put in practice. If anything is seen to be certainly true in theory, it will come right by-and-by in practice. Fulton's steamboat would not work at first, nor did Stephenson's locomotive, nor Daguerre's sun-painting, nor Morse's electric telegraph; and no doubt a great many people said, "Oh! that's true in theory, but false in practice."—*J. F. Clarke in "Self-Culture."*

cational influence of a number of specially skilled mechanics upon the larger mass of workmen surrounding them will be great; their superior skill and zealous interest will inspire those who witness it with a desire to improve, and this influence will spread and perpetuate itself. That the industrial interests with which they are associated will be promoted by their correct and accurate methods cannot be doubted.

While the reasoning and illustrations in the preceding paragraphs refer especially to mechanical pursuits, they apply with equal and in some respects with greater force to other branches of railroad service.

TECHNOLOGICAL INSTRUCTION IN RAILWAY SERVICE A PROFITABLE INVESTMENT.

In short, I thoroughly believe that the greater efficiency which a railway would soon secure over its entire system through the study and application of scientific and economic principles having a direct bearing upon its various departments, would make a technological school specially designed to meet its requirements far more profitable than any other investment of the money that would be required to conduct it.* As our railroad shops are now conducted, there is little or no systematic instruction of apprentices, and, as a rule, it would be difficult to find in such shops foremen capable of giving scientific instruction, even if they had the time and inclination. But through the agency of such schools as herein described our shops would eventually be supplied with competent foremen, and a spirit of progressiveness and healthy emulation would gradually permeate the whole service.

ALL APPRENTICES SHOULD BE REQUIRED TO ATTEND SCHOOL.

I do not doubt but that if our American employers could be brought to realize the value of such schools, they would follow the general European custom of requiring, as a condition of indenture, that apprentices should attend shop or other night schools, and this simple requirement would result in a practical educational movement the beneficent effect of which upon the nation's industries and prosperity is now incalculable.

RAILROAD BUSINESS GROWN BEYOND RULE-OF-THUMB MANAGEMENT.

In the preceding pages of this section it has been shown that, while, in its early history, the railroad business of this country was conducted with fair results by officers and employes who, of necessity, had no previous technical training or experience, but who absorbed practical knowledge as the business expanded, it has now grown to such vast proportions, both as regards its physical operations and its executive management, as to call for great skill, thorough training and broad experience in its operating officers and, in a less degree, also in the rank and file from which they are drawn; while of its executive, administrative and traffic officers it demands a varied and comprehensive knowledge and executive ability fully equal to what is needed to secure success in any other profession. It has also been shown that, generally speaking, our railroad officials have reached their present positions through successive promotions *in grade*, as the result of long experience and service; which, however, was acquired at the expense of culture equally necessary and important in, at least, those who come in contact with the public. Also that in the active competition between rival corporations, those which earliest recognize the necessity for high-grade talent, and provide accordingly, secure direct and material advantages over those that do not.

PROGRESSIVE PROMOTION IN RAILROAD SERVICE DESIRABLE, UNDER CIVIL-SERVICE RULES.

On the ninetieth page of this report I expressed the desire to see the Baltimore and Ohio Company which, admittedly, holds a progressive position among American railways in respect to its treatment of employes, inaugurate what is familiarly

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*Answering by letter an inquiry Mr. Coler made of him concerning the economic value of workshop-school facilities to railroads, General Mauager Webb, of the London and Northwestern Railroad, whose shops are at Crewe, among other things says:

"The provisions under this head (theoretical workshop instruction) are very much appreciated, as you will doubtless notice by referring to the Annual Report which I had the pleasure of handing you when here.

"With regard to the economic results, there is no doubt that the railway company, by supporting such an institution, are able to retain the services of thoughtful, steady men in their employ, not only for their own sakes, but it supplies an educational medium for their boys; and, also, the theoretical instruction imparted, if only to the comparatively few, must have some effect on the intelligence in the shops, which has been found to be the case. Many of those who have received instruction in our classes have, through their application, been intrusted with work in the engine-works requiring mental exercise who would otherwise have been still at the bench.

"This, I think, is, in an economic view, an advantage to the employers, as it does not necessitate their going outside, and consequently giving high salaries to persons required for such employment."

known as a civil-service policy—believing that thereby it would secure greatly increased efficiency and net results. Since penning that paragraph there has been brought to my attention an article in the *Railway Review* of October 25, 1884, on the subject of PROGRESSIVE PROMOTION BASED ON QUALIFICATION AND MERITORIOUS SERVICE, AS WELL AS ON LONGEVITY, which so fitly supplements what has been said respecting the education of railroad apprentices and employes of higher grade, and rounds off this section so harmoniously, that I quote it at length. In my judgment, however, it would be a fruitless task to undertake to inaugurate such a system of progressive promotion among the rank and file and subordinate officers now in our service,—the basic material for such a program not existing therein; but I think that the system of technological instruction of apprentices and railway cadets inaugurated by your circular of January 15, 1885, if carried to its logical sequence, would soon develop that material in abundance.

EXTRACT FROM ARTICLE ON PROMOTION BASED ON MERITORIOUS SERVICE.—RAILWAY REVIEW, OCT. 25, 1884.

The knowledge and ability with which railroad officials of to-day perform the many responsible duties that now devolve upon them are mainly the result of long experience in the service. Such knowledge as this cannot be acquired from books (useful as good books are to every man); the railroads cannot look to any institutions similar in nature to law schools or medical colleges to furnish them the necessary supply of competent and efficient officers. Without the slightest desire to reflect in any way upon colleges or technical schools, it is maintained that but a small proportion of railroad officials or employes (excepting those connected with the engineering department) now or in the future will have more than a good common-school education [unless given by railroads themselves]. The time necessary to secure any better school-education than this can probably be spent to better advantage in obtaining that knowledge of details that can only be acquired by actual service in minor positions.

Accepting the foregoing as correct, it can be safely assumed that the railroads will have to look to their own ranks for their officers of both high and low degree. If this is so, it is clearly to the interests of the railroads to do all they can to elevate the standard of railway service.

So much for the general railway service of the country. And now to come down to the relations that should exist between the individual railway companies and their employes.

If the railway officials of the country must be taken from the lower grades of service, and it therefore is to the interests of the railway system to endeavor to keep the supply of competent men equal to any probable demand, is it not judicious for every railroad company to have among its own employes trained men who are familiar with its own peculiar mode of management, in order to meet any emergency which may arise?

The foregoing has not been written simply to show that it is to the interest of the railway companies to do all they can to promote the efficiency of the service, but to demonstrate that there is a certain identity of interest which should act as a bond between them and their employes, securing to one faithful service and to the other considerate and equitable treatment. The interests of the two are so closely allied that any permanent benefit to one of the parties must necessarily be to the advantage of the other. It is to the advantage of the railroad company that its employes should serve it faithfully; it is to the advantage of the employe that his services should be considered valuable. But, to stimulate the ambition of any man, an incentive is required No man will specially exert himself or endeavor to increase his usefulness to his employer unless he feels satisfied that at some time he will reap some reward for his increased exertions. Why should he? As a matter of fact, without such assurance his services are more likely to deteriorate; he will perform his duties in a perfunctory manner, perfectly satisfied so long as he escapes dismissal. But, on the other hand, let him see that his initial efforts at improvement are recognized, and he is stimulated to still greater efforts.

The railroad service is like an army: while every private cannot, of course, become a general, if he is entitled to promotion by reason of his personal merits he should be made a corporal, at least, on first opportunity, or in some other way receive due recognition for his meritorious conduct. Again, every recruiting officer likes to secure first-class recruits; but to do this he has to show that the service for which he desires to obtain their enlistment possesses special attractions. Now, considering the railway service to be like an army, in what way shall it show its appreciation of meritorious conduct of its employes, and what special attractions must it present in order to secure the enlistment of first-class material?

Permanency of employment is what every workingman desires. Therefore, every employe should have good reason for feeling confident that so long as he performs the duties of his position in a conscientious and faithful manner he is secure in his position; that he need have no fear of dismissal excepting for good and sufficient cause. What the railroad companies should endeavor to impress upon the minds of all employes is, that in entering the railway service they have adopted a permanent occupation in the same sense as a physician or lawyer adopts his particular profession—as a life-work, in which, under ordinary circumstances, he must expect to attain whatever success in life it may be his good fortune to have allotted him. As far as practicable, officials should discourage the employment of any one who is only desiring to secure temporary employment, while awaiting a more auspicious opportunity for engaging in some other pursuit. This class of men are of no practical benefit to the service, as they have no desire to become acquainted with the business; and if they had, would be likely to leave the service before they had acquired even a limited knowledge of their duties.

However, to induce any man to enter the service with the intention of making it his business during life, something beyond the mere fact that he will probably have permanent employment is needed. He must not only feel assured of permanent employment, but he must also be satisfied that he will be likely to better his condition as he becomes more familiar with the business, and when, as a natural consequence, his services are more valuable. Any bright and intelligent young man, full of energy and sanguine to the highest degree, is very likely to think that if his first position in the service (which, in consequence of his lack of experience and technical knowledge, must be a minor one) is to be the one in which he is likely to remain for a long period, and that he stands but a slight chance of advancement, whatever his merits may be, he had better start in some other business which presents better promise of future personal advantage. In his inexperience of the vicissitudes of life, and his unlimited self-reliance in his own natural ability, he is fully convinced that he is predestined to attain success in *something*, although he has but a very hazy idea of what that *something* is to be. But

let him have reason to believe that there is a very fair probability of his securing advancement in the railroad service, if he is willing to work for it and merit it, and in his confidence in himself he will be willing to enter the service and anxious of having an opportunity of proving his ability.

For these reasons—to encourage present employes and to attract the right kind of material to the service—it is very desirable that all vacancies that may occur in any company's service should be filled, as far as practicable, by the promotion of worthy employes from lower positions, instead of giving the position to any outside party, or to some favorite of the higher officials. Let it be fully understood by any company's employes, that all vacancies will be filled from their own ranks, and that no favoritism or partiality will be shown, the appointments being made on the strict merits of each particular case, and the result will in all cases be beneficial.

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The pages of the report proper, which here follow in the pamphlet edition of Dr. Barnard's report, are given in the account of this Technological School of the B. & O. R. R. Co., in Chapter V. of the present volume of this Report. (See ante pages 132–147.) "Exhibits" "A," "U," "V," and "W," which relate directly to the work of the school, are also given. (See ante pages 148–170.) The remaining "Exhibits" follow here.

EXHIBITS.

EXHIBIT B.

Polytechnic School at Zurich, Switzerland.

The Polytechnic School at Zurich, Switzerland, is one of the largest and most successful of its kind. It was established in 1854, and the magnificent building which it occupies is one of the leading features of Zurich. Its citizens are justly proud of the noble edifice and of the great work accomplished by the school in developing their industries, attracting capital to their city, attracting hundreds of students, and sending forth trained specialists to all parts of the world, and generally in improving the condition of all classes of society.

This institution supports a large number and variety of laboratories, libraries, industrial museums, collections of apparatus, and objects of scientific and artistic interest, which of themselves exert a wonderful educating influence upon the thousands of students that resort to them for instruction and training. It makes provision for more than two hundred distinct courses of lectures, given by as many as sixty different professors, many of whom have a world-wide reputation in their respective departments of science. These professors are assisted in giving instruction by numerous tutors, curators of museums, and other servants employed to assist in experiments and to take care of the apparatus.

ITS OBJECT AND INFLUENCE.

The object of the school has from the first been to impart the greatest possible amount of scientific instruction to the artisan classes, and to direct thought and scientific research to the development of industrial arts and trade. In this way there have been brought about a mutual interchange of ideas between science, and the actual application of its principles to manufactures, etc. The direct and indirect benefits thus resulting to the industries of Switzerland and Germany are numerous, and the school receives the hearty support and endorsement of manufacturers, merchants, legislators, and the intelligent citizens in general of both countries. In the most successful factories and commercial establishments of Switzerland and southern Germany, and often in France, are found managers, foremen and leading workmen who have received their education and preparatory training at the Zurich Polytechnic University. These men have not only become experts in their special departments, as a result of their training in this school, but they have learned to study the history, progress and present condition of the industries of their own and other countries; and this knowledge is especially valuable to those whose establishments and commercial interests they conduct. Oftentimes proprietors of large establishments are themselves graduates of this school, and are thereby qualified to perform much executive labor that would otherwise be entrusted to men whose services could be secured only by the payment of large salaries.

But the influence of the Zurich Polytechnic School is not confined to Switzerland and Germany. The impetus that it gives to industrial pursuits is felt and acknowledged in more remote countries. Students come from all parts of the world to profit by the instruction it affords, and, having completed the prescribed course of study, return to their native countries to enter upon careers of industrial labor in which they fully utilize their attainments. Last year six students from different parts of North America entered this school. The English Royal Commissioners testify, that in almost every country visited by them, graduates of the Zurich school were found in the leading industrial institutions, or were teachers in numerous technical schools.

EXHIBIT C.

Technical High School at Munich.

The Technical High School at Munich is similar to the Zurich School. The magnificent buildings in which this school is conducted were erected at a cost of over $775,000, whilst the cost of its various collections exceeded $180,000, and the annual expense of maintaining the school is $100,000. This great institution was founded and is operated with special reference to the higher education of the industrial

classes, and one of its notable features is the numerous subdivisions into which the various subjects taught are divided, each special branch of a subject being taught by a separate professor, who, by limiting his investigations, is enabled to master every detail of his chosen specialty. Thus in the department of engineering forty-five distinct courses of lectures are given by thirteen professors. The school is well supplied with laboratories, in which all kinds of experiments are tried, the results of which are carefully tabulated by the students and recorded in their books. The students in the engineering branch determine the strains and modulus of elasticity of different substances, make numerous tests of the various kinds of wood, stone and other building material, and carry on series of investigations to ascertain constants, to verify formulæ, and to test the strength of metals of various sections, including experiments as to torsion, tension, compression, and the effects of long-continued concussion on the fibre of metal bars.

This testing laboratory, besides having afforded instruction to hundreds of students since it was founded in 1868, has been largely utilized by numerous manufacturers and builders in all parts of Germany, who frequently send materials there to be examined, tested, and reported upon.

Notwithstanding the great capacity of this school in the way of teachers, laboratories, apparatus and class-rooms, some of the departments are overcrowded, and numerous students seeking admission are annually turned away.

EXHIBIT D.

Technical Education in Chemnitz, Saxony.

In 1856 a weaving school was founded at Chemnitz, Saxony, by way of an experiment in technical education. Here practical weaving has been taught for almost thirty years. Mr. Felkin, who wrote a book some years ago on "Technical Education in a Saxon Town," asserted that "the school had been of great benefit to the trade of the town and district," and the British Royal Commissioners, after having visited the schools, say that Mr. Felkin's statement is corroborated by many influential citizens of Chemnitz with whom they conversed, and add that there was a general concurrence of testimony in favor of the school on the part of all manufacturers with whom they talked. The classes are attended by merchants and distributors of goods, and by the sons of manufacturers, as well as by managers, firemen, designers and other workmen. There is not a manufacturing establishment in the town that has not one or more men in its employ whose training was received in the school. Of late years English students have been attending the classes, having selected this school as the best place to receive a preparatory training for the factory. Some enterprising manufacturers from distant cities have sent their managers to take a course in the school at the expense of the firm. A leading feature of this school consists in its provisions for instructing merchants and salesmen in the quality, design and material of textile goods, so that they may be better able to buy intelligently, by detecting faults and imperfections in the nature of the goods, by judging of the merits and demerits of new designs. This feature of the school-work is sometimes opposed by the manufacturers.

So great has been the success of the school at Chemnitz that numerous other weaving schools have been established and modeled after it. Such schools are to be found at Glauchau, Meerane, Loessnitz. Oederan, Milwerda, Hainichen and Frankenberg, all of which places are adjacent to Chemnitz, and where weaving is the principal industry.

EXHIBIT E.

Bradford (Eng.) Technological School.

The citizens of Bradford, England, a few years ago organized a technological college adapted to the wants of the principal industries of that manufacturing centre. The new buildings were opened by the Prince of Wales in 1882, and though the original plan has by no means been perfected, the cost of the buildings and apparatus therein has already exceeded $200,000. When complete it will be one of the best institutions of its character in Europe. Concerning this institution the Royal Commissioners say: "The formation of the college was the result of the prevailing feeling in the minds of many of the commercial community at Bradford that, in the competition of the world's industries, it has become more and more needful to develop, to the fullest extent, the technical knowledge of the employers and operatives in the various industries on which the prosperity of the district depends. It was therefore determined that an institution should be founded in which instruction should be given in the principles underlying the numerous industries of the city and vicinity."

EXHIBIT F.

Conclusions of the British Royal Commissioners.

The conclusions of the British Royal Commissioners, as summed up in their report, though somewhat voluminous, are so thoroughly a digest of industrial development that they will certainly repay careful perusal in full by those interested in the subject; but even the *résumé* of their deductions embraced in the extracts herein quoted illustrates the value of the subject.

[Extracts from the Conclusions of the British Commissioners as to the Effect of Technical Education on Industries.]

* * * It will have been seen from the preceding pages of this report that we have attached considerable relative importance to that portion of our commission which directed us to inquire into the condition of industry in foreign countries; and it is our duty to state that, although the display of Continental manufactures at the Paris International Exhibition in 1878 had led us to expect great progress, we were not prepared for so remarkable a development of their natural resources, nor for such perfection in their industrial establishments, as we actually found in France, in Germany, in Belgium and in Switzerland. Much machinery of all kinds is now produced abroad equal in finish and in efficiency to that of this country, and we found it in numerous instances applied to manufactures with as great skill and intelligence as with us.

In some branches of industry, more especially in those requiring an intimate acquaintance with organic chemistry, as, for instance, in the preparation of artificial colors from coal-tar, Germany has unquestionably taken the lead.

The introduction by Solvay, of Brussels, of the ammonia process for the manufacture of soda, and the German application of strontia in sugar refining, constitute new departures in those arts. In the economical production of coke we are now only slowly following in the footsteps of our Continental neighbors, whilst the experiments which have been carried on for nearly a quarter of a century in France for recovering the tar and ammonia in this process have only quite recently engaged our attention.

The ventilation of deep mines by means of exhausting fans was brought to perfection in Belgium earlier than with us, and, although our methods of sinking shafts served for many years as models for other countries, improvements thereon were made abroad which we are now adopting with advantage.

The abundant water power in Switzerland and in other mountainous districts is utilized for motive purposes by means of turbines perfect in design and execution.

The construction of the dynamo-machine by Gramme gave the first impulse to the general use of electricity for lighting, and to the various new applications of that force which appear likely to exercise so great an influence upon the industry of the world; and in all these applications, at least, as much activity is exhibited on the Continent as with us.

In the construction of roofs and bridges, more especially in Germany, accurate mathematical knowledge has been usefully applied to the attainment of the necessary stability with the LEAST consumption of materials.

PROGRESS OF ENGLAND'S INDUSTRIAL SYSTEM.

The beginnings of the modern industrial system are due in the main, as we have indicated, to Great Britain. Before factories founded on the inventions of Watt, of Arkwright and Crompton, had time to take root abroad, and whilst our own commerce and manufactures increased from year to year, the great wars of the early part of this century absorbed the energies and dissipated the capital of Continental Europe. For many years after the peace we retained almost exclusive possession of the improved machinery employed in the cotton, woolen and linen manufactures. By various acts of the last century, which were not repealed till 1825, it was made penal to enlist English artisans for employment abroad; the export of spinning machinery to foreign countries was prohibited until the early years of Your Majesty's reign. Thus, when, less than half a century ago, Continental countries began to construct railways and to erect modern mills and mechanical workshops, they found themselves face to face with a full-grown industrial organization in this country which was almost a sealed book to those who could not obtain access to our factories.

CONTINENTAL COUNTRIES COMPELLED TO FOUND TECHNICAL SCHOOLS.

To meet this state of things, foreign countries established technical schools like the Ecole Centrale of Paris and the polytechnic schools of Germany and Switzerland, and sent engineers and men of science to England to prepare themselves for becoming teachers of technology in those schools.

Technical high schools now exist in nearly every Continental State, and are the recognized channel for the instruction of those who are intended to become the technical directors of industrial establishments. Many of the technical chemists have, however, been, and are being, trained in the German universities.

FRUITFUL RESULTS OF THESE SCHOOLS.

Your Commissioners believe that the success which has attended the foundation of extensive manufacturing establishments, engineering shops and other works, on the Continent, could not have been achieved to its full extent, in the face of many retarding influences, had it not been for the system of high technical instruction in these schools, for the facilities of carrying on original scientific investigation, and for the general appreciation of the value of that instruction, and of original research, which is felt in those countries.

With the exception of the Ecole Centrale of Paris, all these schools have been created, and are maintained almost entirely, at the expense of the several States, the fees of the students being so low as to constitute only a very small proportion of the total income. The buildings are palatial, the laboratories and museums are costly and extensive, and the staff of professors, who are well paid according to the Continental standard, is so numerous as to admit of the utmost subdivision of the subjects taught. In Germany, as we have stated in a previous part of our report, the attendance at some of the polytechnic schools has lately fallen off, chiefly because the supply of technically trained persons is in excess of the present demand; certainly not because it is held that the training of the school can be dispensed with. The numerous young Germans and Swiss who are glad to find employment in our own manufactories have, almost without exception, been educated in one or other of the Continental polytechnic schools.

GENERAL INDUSTRIAL INTELLIGENCE OF MASTERS AND MANAGERS ON THE CONTINENT.

Your Commissioners cannot repeat too often that they have been impressed with the general intelligence and technical knowledge of the masters and managers of industrial establishments on the Continent. They have found that these persons, as a rule, possess a sound knowledge of the sciences upon which their industry depends. They are familiar with every new scientific discovery of importance, and appreciate its applicability to their special industry. They adopt not only the inventions and improvements made in their own country, but also those of the world at large, thanks to their knowledge of foreign languages and of the conditions of manufacture prevalent elsewhere.

The French and German schools for miners, and the one which has been quite recently founded in Westphalia for workers in iron and steel, differ from the preceding schools for foremen, inasmuch as they are reserved for the theoretical instruction of men who, having already worked practically at their trades, have distinguished themselves by superior intelligence and good conduct. Most of the German schools of this kind are founded or maintained by the manufacturers, and will, we feel confident, repay the trades which have had the foresight and public spirit to create them, by training young men to become foremen and leading hands, willing and able to carry out with intelligence the instructions of their superior officers.

SOCIETIES FOR PROMOTION OF INDUSTRIAL KNOWLEDGE.

In several of the more important industrial centres of the Continent there exist societies, such as the Sociétés industrielles of Mulhouse, Rheims, Amiens, etc., the Société d'enseignement professionnel du Rhone which has its headquarters at Lyons, and the Niederoesterreichischer Gewerbe-Verein of Austria, one of the chief objects of which is the development of technical education among workmen and other persons engaged in industry by means of lectures and by the establishment of schools and

museums of technology. These associations are supported mainly by the merchants and manufacturers of the district to which their operations are restricted. In many cases they are founded and supported, or are greatly assisted, by the Chambers of Commerce; these bodies, abroad, being incorporated, and having, in France, considerable taxing powers over their members, are generally wealthier and more influential than those in our own country. In addition to these sources of income, the associations receive help from the municipality, and sometimes from the State. In Mulhouse, besides promoting education, the society sees to the material well-being of the workmen by erecting, on a large scale, laborers' dwellings (la cité ouvrière), and by organizing savings banks and other economic arrangements; undertaking, in this respect, on a smaller scale, what is done in this country by self-sustaining associations, like building and co-operative societies of the workpeople themselves. The society in Lyons has established numerous evening classes for elementary and technical instruction, which are attended chiefly by workpeople; and the South Austrian Trade Society, which has its central office in Vienna, has organized several technical day and evening schools for operatives of every grade, which are now under State control, and receive subventions from the Government.

MR. MATHER'S REPORT ON THE UNITED STATES AND CANADA.

The report of Mr. William Mather to your Commissioners, on his six months' tour throughout the United States of America and Canada for the purpose of studying the schools and factories of that continent, deserves the most careful perusal. It will be seen that Mr. Mather assigns greater influence on American manufactures to the general education of the American people derived from their common schools than to their technical schools, the importance of which latter, however, in the training of civil engineers, has been experienced for some years, though it has only more recently become recognized by those who are engaged in mechanical engineering and in metallurgical and manufacturing establishments of various kinds. This recognition is, however, now becoming universal. A decided preference is being given in the United States, for the positions of managers and heads of departments, to persons who have received a *scientific training in a technical school*, and the plan is followed in these schools of *combining instruction in "application" with instruction in pure science.* Although the conditions of American industry differ in many respects from our own, there can be no doubt that we may derive great advantage from a careful study of what is being done in the way of technical instruction in the United States, as, together with the elementary education of Canada, it is so graphically described by Mr. Mather. We may add that the accuracy of his statements and conclusions is generally confirmed by the accounts of technical instruction in America which we have received from other competent judges.

SCHOOLS ESTABLISHED AND SUPPORTED BY INDUSTRIAL CORPORATIONS.

Not many years have passed since the time when it would have still been a matter for argument whether, in order to maintain the high position which this country has attained in the industrial arts, it is incumbent upon us to take care that our managers, our foremen and our workmen should, in the degrees compatible with their circumstances, combine theoretical instruction with their acknowledged practical skill. No argument of this kind is needed at the present day. In nearly all the great industrial centres—in the metropolis, in Glasgow, in Manchester, Liverpool, Oldham, Leeds, Bradford, Huddersfield, Keighley, Sheffield, Nottingham, Birmingham, the potteries, and elsewhere—more or less flourishing schools of science and art of various grades, together with numerous art and science classes, exist, and their influence may be traced in the productions of the localities in which they are placed. The schools established by Sir W. Armstrong at Elswick; by the London and Northwestern Railway Company at Crewe; and those of Messrs. Mather and Platt, of Salford, in connection with their engineering works, testify to the importance attached by employers to the theoretical training of young mechanics. The efforts of Messrs. Denny, the eminent shipbuilders of Dumbarton, for encouraging the instruction of their apprentices, and for rewarding their workmen for meritorious improvements in details applicable to their work, are proofs of this appreciation. The evidence of Mr. Richardson, of Oldham, and of Mr. Mather, of Salford, is emphatic as to their experience of its economical value.

Without more particularly referring to the valuable work in the past accomplished by the numerous mechanics' institutes spread over the country, many of them of long standing, we may point out that they are now largely remodeling their constitutions in order to bring up their teaching to the level of modern requirements as regards technical instruction. The example of the Manchester Mechanics' Institute may be studied in this connection.

Moreover, as evidencing the desire of the artisans themselves to obtain facilities for instruction both in science and art, we must not omit to mention the classes established and maintained by some of the leading co-operative societies. The Equitable Pioneers' Society of Rochdale has led the way in this, as in so many other social movements. It is much to be wished that the various trades' unions would also consider whether it is not incumbent on them to promote the technical education of their members.

The manufacturers of Nottingham speak with no uncertain voice of the important influence of the local school of art on the lace manufacture of that town. Without the Lambeth School, the art productions of Messrs. Doulton could scarcely have come into existence. The linen manufacturers of Belfast are becoming alive to the necessity of technical instruction, if competition on equal terms with foreign nations in the more artistic productions is to be rendered possible. The new generation of engineers and manufacturers of Glasgow has been trained in the technical schools of that city. The City and Guilds of London Institute owes its existence to the conviction of the liverymen that technical instruction is a necessary condition of the welfare of our great industries.

Natural science is finding its way surely, though slowly, into the curriculum of our older English universities and of our secondary schools. It is becoming a prominent feature in the upper divisions of the elementary board schools in our large towns. There are scarcely any important metallurgical works in the kingdom without a chemical laboratory in which the raw materials and products are daily subjected to careful analysis by trained chemists. The attainments of the young men who have been trained in the Royal Naval College at Greenwich recommend them for remunerative employment by our great shipbuilding firms.

In our relations with public bodies and individuals in this country during the progress of our inquiry, the greatest anxiety has been manifested to obtain our advice as to the mode in which technical instruction can be best advanced, and we have to acknowledge the readiness of the Education and Science and Art Departments to receive and act upon suggestions in matters of detail from individual members of the Commission which it would have been pedantic to delay until the completion of our task. Amongst the suggestions which have thus been made was that of an exhibition of the school work of all nations, which His Royal Highness the Prince of Wales has consented to add to the Health Exhibition of 1884. This exhibition will be an appropriate illustration of the account of foreign schools contained in the previous parts of this report. Your Commissioners, during their Continental visits, received from the authorities of technical schools numerous assurances of their cordial support and co-operation in such a display.

HOW THE COST OF SCHOOLS SHOULD BE BORNE.

In considering by whom the cost of the further development of technical instruction should be borne, we must not forget that, if it be true that in foreign countries almost the entire cost of the highest general and technical instruction is borne by the State, on the other hand, the higher elementary and secondary instruction in science falls on the localities to a much greater extent than with us; whilst, as to the ordinary elementary schools, the cost in Germany and Switzerland is almost exclusively borne by the localities; and this was also the case in France and Belgium until the people of those countries became impatient of the lamentable absence of primary instruction on the part of vast numbers of the rural, and, in some instances, of the town, population; an evil which large State subventions alone could cure within any reasonable period of time. With the exception of France, there is no European country of the first rank that has an Imperial budget for education comparable in amount with our own. In the United Kingdom at least one-half of the cost of elementary education is defrayed out of Imperial funds, and the instruction of artisans in science and art is almost entirely borne by the State. Hence, it will be necessary to look, in the main, to local resources for any large addition to the funds required for the further development of technical instruction in this country.

EDUCATIONAL VALUE OF MUSEUMS.

We cannot dismiss this branch of the subject without calling attention to the educational value of the museums of natural objects now found in many of the modern elementary schools of the Continent. Probably the best examples of such collections are those of the Normal School of Brussels, and of the elementary schools of Zurich. Collections of natural objects, pictures and diagrams are of the greatest assistance for illustrating object lessons in rudimentary science to children of the earliest years.

FREE LIBRARIES.

Many persons who have paid attention to the working of free libraries in our large towns, are of opinion that the benefit of these might be extended to elementary schools by placing at the disposal of such schools books of a character calculated to interest children of school age. Amongst these books some suitable technical works, especially illustrated ones, might be included. These school libraries would be of the nature of the branch libraries which are now attached to many of the free libraries of our large towns.

MANUAL TRAINING AS A PART OF SCHOOL WORK.

Your Commissioners, after having had the opportunity of further considering the value of manual work as a part of primary instruction, and after having seen such work introduced into elementary schools of various grades in other countries besides France, are able now to express a stronger opinion in its favor than at the time of their first report. They do this with greater confidence because, in consequence partly of the suggestion contained in that report, the experiment of introducing manual work into primary schools has been successfully effected by at least two school boards in this country—viz.: those of Manchester and Sheffield. They have had the opportunity of inspecting the manual work of the pupils both at the Manchester Board Schools and at the Central School in Sheffield, and they are satisfied that such work is very beneficial as a part of the preliminary education of boys in this country who are to be subsequently engaged in industrial pursuits, even though it should not, as, however, it probably will do, actually shorten the period of their apprenticeship.

EXHIBIT G.

English Science Schools and the City and Guilds of London Institute.

The English Government is beginning to make liberal provision for the higher training of artisans. Its great international exhibitions have served to arouse a spirit of national pride among the English people. They have seen themselves outstripped in the race for national supremacy in articles of manufacture, but they are resolved to regain their former prestige as a nation of first rank in art. This spirit of national pride, combined with that indomitable enterprise which is so characteristic of the English race, and which is just now quickened by the depression in trade and the intense rivalry that results from sharp competition with Continental nations for control of the great industries and home and foreign commerce, together with the necessity of making some provision for the employment of the thousands of men and women who are dependent upon their daily earnings for their livelihood, and of making such a disposition of the children of those people as will prevent their becoming paupers, vagabonds and criminals, has taken a practical turn by endeavoring to place the means of acquiring a special training for some field of productive industry within the reach of all.

SOUTH KENSINGTON SCIENCE AND ART SCHOOLS.

But the English Government does more than merely provide schools and apparatus. It has a great university of science and art at South Kensington, where the ablest instructors that the nation has produced are employed and furnished with every needful facility to train special teachers for the highest departments of artistic manufacture, and for the various schools of industry that are being established in every industrial centre. The Government also holds out inducements in the way of prizes and scholarships as incentives to young people to enter the schools and complete the prescribed courses of study.

The great tendency of the Government schools, however, is to provide for the teaching of pure science only, or of applied science only in a theoretical way. To supplement this theoretical instruction by making a direct application of the science thus taught to the development of the numerous national industries, efforts have been put forth in various directions to provide for a corresponding development of skill by training the hand, the eye and the taste of persons engaged in manual pursuits. The greatest of these attempts is the one that has been made by the numerous guilds of London. These organizations have been accumulating great stores of wealth for several generations, and of late years they have wisely determined to utilize their hoarded treasures by establishing and sustaining schools for both the secondary and the higher training of people who, like themselves, are engaged in industrial avocations.

CITY AND GUILDS OF LONDON INSTITUTE.

Accordingly they have formed what is known as the City and Guilds of London Institute, the purpose of which is to provide for and encourage education adapted to the requirements of all classes of persons engaged, or expecting to engage, in manufacturing and other industries. Recognizing that the teaching of pure science is so extensively provided for by the Government, this Institute makes no attempts in that direction, but confines its efforts to technical education in the true sense of that expression—*i. e.*, the development of skill and the acquisition of manual dexterity in industry—by uniting manual training with science teaching, and basing all shop instructions upon scientific principles.

The guilds are organizing a number of technical schools in various parts of London for the education of the artisans of the great metropolis, and to serve as models of schools to be founded in other cities and towns of the kingdom. These schools are to be supported in part by fees and local efforts, and in part by grants, conditioned on results, from the Government and from the guilds. The Institute also aims to induce existing educational institutions to make provision for technical education, and they make yearly grants to these institutions, providing the education they furnish is of such a character as to satisfy the Council of the Institute. When the existing institutions make provisions sufficiently varied and extensive to meet the requirements of a community, the guilds make no effort to establish a separate school there.

The guilds also encourage the formation of evening classes, in which boys and men engaged in the performance of their duties during the day receive special instruction in the principles of science, and in the application of these principles to the various processes that engage their attention in the shops and factories. They now assist in the support of evening classes in technology, as distinguished from the Government classes in science and art, in nearly all the large centres of industry.

CENTRAL INSTITUTION AT SOUTH KENSINGTON.

The guilds of London have also established, and propose to maintain, a great central institution at South Kensington, near the National Industrial Museum and the South Kensington School of Science and Art. This central institution is similar in many respects to the polytechnic schools of Germany, Switzerland and Italy, and to the École Centrale of Paris. It is designed to supply the instruction and training that cannot be obtained in any of the smaller technical schools, and to give the highest possible training to manufacturers, managers, foremen, and teachers of technology. This institution will afford an opportunity to many ambitious young artisans to secure the highest technical training who otherwise could not do so, as their circumstances would not permit them to attend any of the polytechnic schools on the Continent.

The City and Guilds of London Institute is thus one of the most potent educational organizations in Europe, and if it continues as it has started out, its achievements in behalf of industry and the industrial classes will be without a parallel in the history of the world. Its magic influence is already felt and acknowledged throughout the length and breadth of the kingdom.

NOTICE OF A FEW SCHOOLS SUSTAINED BY INDUSTRIAL CORPORATIONS.

Conspicuous among the schools in England sustained by industrial corporations for the benefit of their employes are those of the London and Northwestern Railway Company at Crewe, of Sir William Armstrong & Co. at Elswick, and of Messrs. Mather & Platt, extensive iron manufacturers, at Salford, near Manchester. The object of each of these schools is to enable apprentices to study the sciences allied to their trade. The first two of these schools do not make attendance compulsory, but as the companies sustaining them each employ about ten thousand workmen, the evening classes are attended to their full capacity by voluntary students. At Crewe the number enrolled in the school for the last year exceeded six hundred, which was as many as could be accommodated in the large school building which has been erected and equipped by the London and Northwestern Railway Company. Among these voluntary students were many journeymen who were ambitious to surpass their present educational attainments. Mr. Webb, the efficient General Manager of this company, was the moving spirit in the organization of the school at Crewe, and he continues to be an earnest advocate of technical training for railroad employes.

ATTENDANCE AT SCHOOL A CONDITION OF EMPLOYMENT OF APPRENTICES.

Messrs. Mather & Platt require all their apprentices, as a condition of employment, to attend the evening classes in the technical school which the firm has established, and the manager of their works claims that the boys make better headway in acquiring their respective handicrafts by acquiring the related technical knowledge at the same time.

The theoretical instruction in all three of the schools just referred to is very much the same, including mathematics, mechanics, physics, chemistry and engineering. Instruction is also afforded in drawing, machine construction, building construction, and the use and care of tools.

EXHIBIT H.

Testimony of Mr. Stephen, of Glasgow.

Mr. Alexander Stephen, in a speech before the graduating class of the Allen Glen's Institution, Glasgow, made some pertinent remarks on the subject of technical education, the substance of which was that it is only within the last few years that the importance of teaching science subjects in the schools of the country has come to be realized, and it is satisfactory to observe that the desire for this teaching is increasing from year to year. In past generations facilities for obtaining a knowledge of science subjects were very limited, but now there are institutions and schools where the studies can be carried on which lay the basis and give the taste for science training, so that when the student goes forward to the practical work of daily life, he is the better fitted to take a leading part in the performance of its duties. If the young student can be got to master the first principles of any science to which he may have given his attention in a technical school, he has put himself in the way of being able to prosecute scientific studies successfully in after years, and may even rise to distinction or confer a boon upon society as a consequence of his researches. At the same time the boy is acquiring manual skill he should have an opportunity to continue his elementary education, which will otherwise be of little value to him. The technical school affords this opportunity, and while the boy is taught *to do* he is also taught *to think* accurately on scientific subjects. Science teaching becomes

more and more necessary for the development and success of the manufacturing and other industrial interests of the country. It is a fact that, owing to the greater attention that other countries have given to technical teaching, we have been obliged to have recourse to foreigners to fill positions as designers in our factories. I am informed that this is so in Glasgow, but I think that we are now on the road to overcome this necessity.

In the report of the Royal Commission on technical instruction it is stated, alluding to schools in other countries, that the best examples of higher elementary schools are to be found in France; and in these schools it is said that "the children of artisans and of small shopkeepers have opportunities of obtaining an education which is technical in so far as these studies are directed toward the requirements of commerce, mechanical or manufacturing industry—mathematics, science and drawing constituting the main subjects of instruction. And in nearly all the modern French schools—of which that at Rheims may be taken as the best type—the laboratories for teaching practical chemistry leave nothing to be desired. In these schools the workshop instruction is carried to a much more advanced stage than is possible or desirable in the elementary schools; and there are special departments, replete with models, apparatus and specimens, for teaching the technology of the trades which form the staple industries of the district in which these schools are situated." The Germans are considered to be much ahead of us in technical training, but, now that we have made a start, I trust that we shall soon be ahead of them. Improvements and new discoveries, whether in engineering science or in other mechanical contrivances, are most likely to be made and applied in the light of scientific knowledge.

EXHIBIT I.

The Martin School, Lyons, France.

[Extracts from report of British Commissioners.]

This school was founded 50 years ago by a bequest from Major-General Martin, who left Lyons a poor boy, fought against the English under Tippoo Sahib, and entered the service of the East India Company after Seringapatam had fallen. More than 20 years elapsed before the city of Lyons could recover his legacy from the Indian courts, and the school was at length established in 1830 on the remnant saved from the lawyers. The school was intended to give to the poorer classes of Lyons an education which should enable them to improve their position in after-life. M. A. Monmartin thus sets forth the object which the founders of the Martinière had in view in creating this industrial school. "The intention of this school is to instruct the son of the workman, of the artisan, of the small manufacturer or the tradesman of Lyons gratuitously in the sciences and arts applied to industry; to develop in him, on the sole condition that he is intelligent, moral and industrious, those aptitudes which will most surely conduct him to well-being, if not to fortune, and to create new elements of productive force and of future prosperity to the country."

The building, adapted and furnished at a cost of $200,000, contains good class-rooms, each capable of accommodating 80 pupils, a very large drawing-room, in which all the pupils of the different divisions can work at once, workshops, laboratory, museum, library, council-room, director's office, etc., together with several dwelling-houses for the head master and other officials.

The school is presided over by an administrative commission composed of seven members, who are nominated by the Minister of Agriculture and Commerce on the recommendation of the municipality. The appointment is for seven years, and one member retires annually, but is eligible for re-election. The Mayor of Lyons is the *ex-officio* President of the Commission, and the trustee of the fund, under the will of Major-General Martin, is the Vice-President. This committee appoints and dismisses the teachers, selecting them as far as possible from the old students of the school, but they must have completed their instruction as masters, and have obtained the diplomas of secondary teachers, and, for employment in some branches, of superior teachers.

A principal, a vice-principal, and five superintendents form the administrative staff, and the instruction is carried on under the care of 40 masters and 10 assistant teachers. These latter constitute a division of masters in training, and form an integral part of the organization for teaching, as well as for disciplinary purposes. There are also a registrar and a chemical assistant. * * *

The Professional School of Rheims is a school of a somewhat higher type than the foregoing, and is one of the best of the higher elementary schools which the Commissioners have seen. It was founded on the model of the schools of Mulhouse and Nantes, and differs from the Martinière school by the further development of manual labor in the shops.

The school was established in 1875, in order to impart to the youths of the city of Rheims special practical knowledge of manufactures, and to train them early to satisfy the requirements of her trade and commerce. A municipal commission composed of city councilors, leading manufacturers and tradesmen of the district came to the conclusion that professional education ought properly to be the continuation and the normal development of primary education, and that such a school as this should draw its pupils from those children of the elementary schools who had passed a satisfactory examination.

There is an entrance examination for those who do not possess the leaving certificate of the primary school. The boys enter the school at about the age of thirteen, and the course of study extends over three years. During the first two years all the pupils pass through the same course of theoretical and practical instruction, and the course up to this point serves also as a preparation for the École des Arts et Métiers at Châlons. Very few boys leave at the end of the second year. There is an examination at the end of each year to determine the promotion to the superior division.

In order, moreover, in the brief space of three years to train up these boys so as to be capable of rendering real service on quitting the school, it has been found necessary to enable them to supplement their theoretical studies with practical work analogous to that which they will have to practice in their future professions, and to place at their disposal a complete and well-organized plant for this purpose. Rheims has spent $80,000 to $100,000 on this plant, and has thus placed her schools in the first rank of similar institutions.

The school has quadrupled its number of students since its foundation in 1875, and the number of boarders would be largely increased if sufficient funds were available to defray the cost of another boarding-house. This school received the gold medal at the Exhibition of 1878.

The Professional School of Rouen.

The Professional School of Rouen is another school, much of the same type as the foregoing, but in which more attention is paid to mechanical industries. This school, which was also visited by the Commissioners, was founded in 1853. The director is M. Delarue. The special object of the instruction is to prepare youths to enter the École des Arts et Métiers, but a certain number of the pupils leave the school to enter at once into practical work. The bulk of the pupils are the sons of the small

tradespeople of the town; some of them enter with scholarships given by the Government, or by the municipal authorities. There are six exhibitions given by the city of Rouen, twelve by the Department, and four by the State. The education at this school became gratuitous under the law of July, 1881. The school expenses, hitherto paid by the town, have amounted to about £1120 annually. The school course, which combines both theory and practice, extends over three years, and is conducted in very indifferent premises. The boys must be at least twelve years old on admission, and must have the amount of knowledge necessary for the primary-school certificate. Prizes and medals are given to deserving pupils at the end of each year. Frequent visits are paid to works and factories. There is a chemical laboratory, but the instruction in this subject seems to be inferior to that of the Rheims school. Instruction in the English language is given to all the pupils. There are about 140 students, half of whom are boarders, and there is a preparatory course for the younger boys. The hours of theoretical study are from 7 in the morning till 6 at night, with three hours of recreation, and in the evening two hours of manual work. They therefore have eight hours of class work and two hours of manual work per diem. The practical instruction consists in working in wood and iron. The handicraft work is carried on in a large room lighted from the top, having desks for drawing down the centre, and working benches against the walls; all the pupils work in this room at the same time. The pupils are put through a graduated series of manipulations; for example, in smiths' work and turning of iron, each pupil has to make in succession every one of the hand-tools mentioned in a list and figured on a table hung up in the workshop. The boarders pay from £24 to £26 per annum. Many of the pupils, after having passed through the school, ultimately obtain situations as foremen; others enter the Government schools of Châlons or Angers. At a recent examination, ten pupils from this school presented themselves for the entrance examination for Châlons, and nine were admitted, being one-eleventh of the total admissions for the year. This fact was quoted to prove that the school is a good one.

The director stated that the object of the education was not to form foremen, but rather to give a *general education*, calculated to serve as the basis for many trades. He pointed out a school museum containing specimens of various products for object lessons, and stated that similar museums were about to be formed in all primary and higher elementary schools in France. Amongst the specimens, the Commissioners noticed a Prussian soldier's helmet. On being asked why it was placed there, the director stated that it was picked up during the German invasion, and added that it was his custom to point out to his scholars that France lost her best provinces through the superior education of the invaders, and the helmet served as a constant warning and stimulus to the students.

EXHIBIT J.

Westphalia, Germany, is a great centre of iron and steel manufacture. In order to supply their shops with competent managers, foremen, and workmen, the employers have succeeded in establishing a number of schools designed to combine theoretical scientific instruction with workshop practice, and the success of this attempt has been very satisfactory. At Bochum is situated one of the best of the schools. It was the result of private enterprise, and is gaining in efficiency each year. Instruction is given in moulding, steel-working, iron-rolling, smithing, fitting, turning, and pattern-making, together with drawing and both elementary and higher science. In order to insure that the instruction should not run into the purely theoretical, no student is admitted who has not served a year or more as workman in some shop. This preliminary service, it is claimed, leads students to appreciate and apply the instruction given in the school.

The employers of labor in Westphalia lay great stress upon attendance at the evening schools, requiring all boys under 18 in their employ to attend the classes two or three evenings of each week. A register of attendance is kept, and this is daily inspected by an overseer, whose duty it is to look after all absentees and see that they give a satisfactory account of themselves. It is said that parents willingly co-operate with the employers in securing regularity of attendance at the schools, and that the boys usually appreciate the instruction afforded them.

EXHIBIT K.

J. G. Fitch, an English educator of acknowledged ability, says:

We shall, I hope, ere long, come to the conclusion that the true way to recognize the claims of what are called modern subjects is not by the erection of separate modern departments, but rather by taking a wiser and more philosophical view of the whole range and purpose of school education.

It is not good that the boy who is to be a classical scholar should grow up ignorant of physical laws. Still less is it good that the boy who shows a leaning toward the natural sciences should be debarred from the intellectual culture which literature and language give. * * *

There comes a time, no doubt, when it is clear that we should specialize, but this time does not arrive early; and, until it arrives, it is important that we should secure for every scholar a due and harmonious exercise of the language faculty, of the logical faculty, of the inductive faculty, as well as of the powers of acquisition and memory.

In this connection the following quotations from the catalogue of the Ohio State University is very appropriate:

In nearly every department of life the demand for knowledge and skill is constantly rising. The public is learning to appreciate quality in work. Facility, precision, finish, are acquiring new value. As a consequence the chances of the untrained and the ill-trained are rapidly diminishing, and those who presume to adopt pursuits without the requisite preparation find themselves placed under disadvantages that grow more serious every year.

To meet this increasing demand for a higher order of training, new educational methods are being introduced. That men may be well equipped for their work, it has been found necessary to make their preparation for it a part of their education. The young man who is to become a civil engineer should receive practical training as an engineer. If he is to become a chemist, he should receive practical training in the laboratory. Many look no farther than this; but technical training should be based on scientific training. The civil engineer should not be content with knowing how to handle his instruments, but he should be a mathematician of extensive attainments and ready skill, and should be master of the principles of physics and mechanics. The chemist should not rest in a knowledge of processes and manipulations, but he should be well versed in chemical philosophy. In medicine, in law, in teaching, on the farm and in the shop, in every occupation which involves human interests and requires the application of human intelligence, empiricism should be supplanted by scientific knowledge.

There is no employment in which intelligence is not worth more than mere manual dexterity. A man of scientific knowledge and training, other things being equal, will even shoe a horse better than

one who lacks them. The educated hand is a hundred times better than a hand without education. But the educated hand is made a hundred times better by being placed under the direction of the educated brain.

EXHIBIT L.*

Facilities now Afforded in United States for Technical Training.

This exhibit contains a brief account of the nature, organization, and work of most of the leading industrial schools of the United States, including the industrial departments of some of the great universities. It aims to show to what extent facilities for technical education are now afforded in our country. The information has been obtained from various sources. * * *

The Rose Polytechnic Institute, Terre Haute, Ind.; the Cooper Institute, New York City; Mechanics' Institute, Cincinnati; Technical Schools in Cleveland and Toledo; Pardee Scientific School, La Fayette College, Easton, Pa.; Miller Manual Labor School, Virginia; Working Man's School, New York City; Industrial Training in Cornell University; School of Mines, Columbia College; the Massachusetts Institute of Technology; Worcester County Free Institute of Industrial Science, Mass.; Washington University Manual Training School, St. Louis, Mo.; Girard College, Philadelphia; Stevens Institute, Hoboken, N. J.; Rensselaer Polytechnic Institute, Troy, N. Y.; Mechanical Course, Purdue University, La Fayette, Ind.; School of Agriculture and Mechanic Arts, University of California.

EXHIBIT M.

[Extracts from Mr. Mather's report.]

Mr. Mather, in concluding his report to the British Commissioners on Technical Education in the United States, says:

TECHNICAL AND SCIENCE SCHOOLS IN AMERICA.

It will be seen, from the foregoing description of the technical and science schools, that there exist in America a certain number of *high-class* institutions for technical and scientific training in mining, civil and mechanical engineering. I am of opinion that in these branches, judging from my own observation, there is nothing better of the kind, though such institutions are more numerous at present in Europe. The advantage of the training in the best of them is its *practicalness*. The students feel that careers are open to them if only they have acquired the art of applying their knowledge; hence their ambition is excited, and every one of them appears to be working for a definite purpose. There is nothing pretentious about these students. Some of them are poor, but they must have shown marked ability in order to get the advantages of the free, or partially free, instruction. Thus a limited number of clever sons of workingmen have the road opened up for a thorough scientific training, if they can afford to give the time.

It is much to be deplored that in the majority of institutions in America where science is taught in the abstract there are no departments arranged for such technical training as exists in some I have described.

THESE SCHOOLS CANNOT SUPPLY THE DEMAND FOR INDUSTRIAL TRAINING.

The demands made upon those which give technical instruction are greater than they can satisfy. This accounts for the high fees charged, and also for the fact that the advantages of such technical schools are in the main confined to the sons of wealthy manufacturers or professional men.

The lower-grade science schools connected with the numerous colleges in every State, and semi-private institutions, as described under the head of "Universities and Colleges," are rendering considerable service in the direction of science-teaching to a less wealthy class in the country. Their courses of study, however, require remodeling. To each one of them ought to be attached departments similar to those at Cornell University and Washington University, with ample provision for the admission of free students.

There appears to be excellent provision made in America in such colleges as the Johns Hopkins of Baltimore, and Columbia College of New York, and the like, for the training of able professors and for the continued development of original research in all the sciences. The "Sheffield School of Science," connected with Yale, and the "Lawrence Science School" of Harvard University, may also be classed amongst institutes aiming at the higher education in scientific knowledge.

There are also sufficient schools and colleges, aided by the taxes of the people, to supply, if properly used, ample opportunities for the whole industrial population—proprietors, foremen and workpeople—to acquire, in early life, a sound scientific education by means of a technical course of studies. The only change required is in the curricula of such institutions, and the broadening of their systems to the wants of the age.

MUCH HAS BEEN DONE BY THESE FEW SCHOOLS.

There can be no doubt that America owes much already to the schools which exist for technical education, though not actually helping the artisan class. Many hundreds of young men have been furnished from these sources for the superintendence of railway works, mining operations, machine shops and the textile industries, besides chemical work, glass manufactories, building operations, agriculture, etc. I have met in almost all the manufactories I have visited—from mining, iron and steel manufacturing, through all the mechanic arts, up to watchmaking and sewing-machine manufacturing—evidences of the influence of the technical schools.

* * * * * * *

DISPOSITION TO DEPEND ON PUBLIC SCHOOLS.

From many conversations with owners of industrial establishments I find the prevailing idea to be that everything appertaining to education is to be done in the public school. Moreover, the general aptitude, inventiveness and industry of the American young men, animated always by ambition, and

* As accounts of most, if not all of the institutions referred to, are given at length in the volumes of this Report, only the names of the institutions are here reprinted, to show the extent of Dr. Barnard's investigations.

backed by the ability to read, write and reckon well, have furnished employers with intelligent mechanics after a comparatively short service in the workshops. All Americans have, more or less, the mechanical faculty. It is the characteristic of the race. The problems involved in settling the country have been more mechanical than political. In early times almost all men and all women were engaged in manual work and in exercising their wits to avail themselves of the forces of Nature. To this natural bias the public-school education gave the means for higher development. The demand for mechanical contrivances to save labor held out the promise of great reward, and the protection of cheap patents gave confidence and security. Thus the workingmen of America have been educated and brought up under conditions different from those prevailing in Europe.

EVIDENCES OF AMERICAN INGENUITY.

It is impossible to traverse this vast continent without witnessing the evidences of originality of application founded on scientific principles, and of a development due to education in the mechanical arts. In the railroad system, from the locomotive to the baggage-car, there are original design and marked ingenuity in every contrivance; in bridge-building, great daring and ready devices for temporary, yet safe, structures; in the navigation of rivers there are boats which differ from all European systems. The shallow rivers, like the Mississippi in summer, are navigated for a thousand miles by steamers drawing less than twelve inches of water. The Ohio conveys from Pittsburgh thousands of tons of material by boats drawing nine inches of water. Towns like Chicago, Denver and San Francisco are built under difficulties which require an entire departure from all old methods of applying science. The produce of the great agricultural regions suggested new modes of tilling, sowing and reaping, and in agricultural machinery the Americans showed how quickly and directly science could deal with vast products which would rot on the field but for mechanical skill to preserve them. The same aptitude that dealt with the overwhelming abundance of the West has turned to account the sterility of the East, where, in Maine, New Hampshire and Vermont, the mechanical skill of the farmer in devising economical methods has contributed as much to his support as his knowledge of cattle and crops.

APPLICATION OF SCIENTIFIC PRINCIPLES OBSERVABLE ONLY IN MORE RECENT STRUCTURES.

It is, of course, in the more recent structures and modern mechanical appliances that the evidence of scientific truths and methods is observable. The rough-and-ready contrivances of early railroad development indicate originality and "mother wit"; but in the waste of material and crudeness of design may be noticed the absence of technical or scientific training on the part of those who conducted extensive engineering or mechanical operations in those days. The gradual diffusion of science is very marked in the rapid reconstruction, during recent years, of the great railroads of the past and in the new main lines. Also, in railway plant generally, the old is being replaced by the new, and the latter exhibits high theoretical knowledge combined with practical ingenuity.

AMERICANS OWE MUCH TO EUROPE.

The Americans undoubtedly owe to European engineers the rapid advance they have been able to make in their public works. The conservation of waterpower for the use of the mills at Lowell and Lawrence, in Massachusetts, is due to the eminent hydraulic engineer, Mr. Frances, an Englishman, who practised for forty years in America. The water rights of a district are held in trust for the whole community by a board or corporation elected for the purpose. The power is distributed according to the share which may be purchased or rented by the users, but regard is had to the rights of all, and its utilization requires great skill and knowledge to prevent loss of power. Mr. Frances has had charge of this important work for many years, and is deservedly esteemed as the highest authority on hydraulic engineering in America. Although a lucrative field was, in the early days, open to European engineers and machinists having a thorough scientific knowledge of their profession, yet it is evident that they found apt scholars, who, as they acquired some theoretical science, launched out into new paths, untrammeled by the traditions of the older countries.

Even the science of foreigners, when applied here, takes different methods. The Englishman and German become bold and self-confident to a degree only manifested by rare men in Europe. The everlasting thirst for *something new* excites, stimulates and drives men to venture into untrodden paths in applying their knowledge. In the manufacture of machine tools and every kind of mechanism where the interchangeability of parts would be an advantage, the design and construction have been made subservient to this law. It may be truly said that the Americans have carried to its utmost limits one of the greatest improvements in modern times in mechanical construction—namely, in their extensive introduction of the principle of the interchangeability of parts in machinery. Watches, sewing-machines, tools, agricultural implements, printing-presses, firearms, etc., are made with an accuracy so fine as to approach the theoretical, and yet more cheaply than the rudest and most imperfect work. All these evidences of scientific skill speak well for the methods of education in the recent past, so far as it goes; but other influences, such as "necessity is the mother of invention," and the presence in America of foreign experts, will account for much of the rapid growth in the mechanic arts.

TECHNICAL SCIENCE SCHOOLS ESSENTIAL TO FUTURE DEVELOPMENT.

The future development will depend upon a population not compelled to dare and endure and experimentalize for "very life." In the past the waste of material has been excessive. To make the best use of a given quantity of material requires a sound knowledge of its properties and of its disposal in the arts and manufactures by scientific methods. In this direction the technical and science schools already instituted have accomplished much in providing foremen and managers, chemists, miners, and intelligent employers in the engineering and manufacturing industries. Some extensions of these institutions are now being promoted. One significant indication of progress in this direction was afforded me during my travels. I attended a convention of about a thousand teachers, professors and principals of schools and colleges at Saratoga, and another similar gathering in the White Mountains. The discussion of technical and industrial training was the chief feature of the conventions. I was much impressed by the high qualities of culture and character which distinguished this truly "Grand Army of the Republic" in its 300,000 teachers, as represented at these meetings. If this force should be directed by a change of tactics, so to speak, in the schools to scientific and technical instruction, and to less concentration upon purely literary subjects, there can be no doubt that America will solve the industrial-education question more rapidly than any other country and utilize it in the further development of her inexhaustible resources.

It must not be supposed that Nature has bestowed her gifts over this continent in such wise that they can be enjoyed without much skill and labor in the gathering of them. No country offers more

difficult problems to the engineer, the agriculturist and the manufacturer. A climate of extremes; a scarcity of water in the West; the difficulties of cheap transport and distribution, all require the highest qualities of self-reliance and endurance, with scientific knowledge, in the progress of the future. * * *

JOHNS HOPKINS UNIVERSITY.

This splendidly endowed institution (the Johns Hopkins University) is taking rank amongst the highest universities of America. The regular curriculum of a university course is followed here. The University was opened seven years ago. The bequest of Johns Hopkins amounted to £700,000. The interest was allowed to accumulate until a sufficient sum had accrued to enable the trustees to erect handsome and commodious blocks of buildings on land bequeathed by the founder.

* * * * * * *

This University is devoted chiefly to the highest branches of education in mathematics, physics and medical science. It is conducted on the lines of Owens College of Manchester, with a bias more specially to original research and scientific discoveries, both in chemistry and physics, than to preparing for industrial pursuits. There are no night classes, so that all the teaching is confined to those who can afford to pass through all the courses in the day classes. Dr. Gilman informed me they had some instances of workingmen having, at great self-sacrifice, come to them to obtain a thorough scientific education. The total fees for all subjects amount to £16 per annum.

Dr. Gilman, in answer to my inquiries, stated that some of their professors had delivered popular lectures to the working classes, but he did not regard these as having much influence on working-people generally, in relation to their occupations. He would gladly use the institution as a means of technical training, but did not yet know of a scheme that was practicable there.

* * * * * * *

ONE UNIVERSITY MIGHT GREATLY PROMOTE THE TECHNICAL TRAINING OF WORKERS.

One might expect from so richly endowed an institution a more direct relation to scientific industry than appears now to be the case. With an income of £30,000 a year without fees, it would appear possible for a large amount of work to be done among the people of the city without in any degree diminishing the highest instruction in the advanced stages of literary and scientific knowledge.

Baltimore does not possess any large or distinctive manufactures. The trade is chiefly that of timber and grain export, with workshops for railway purposes. The Baltimore and Ohio Railway shops employ 3000 artisans, for whom there is little provision for science instruction beyond the drawing classes I have described.

I found much interest displayed in the question by the authorities of the railway to whom I was introduced, and they expressed their desire and intention to provide suitable science schools for their workpeople.

EXHIBIT N.

Ex-Commissioner Eaton's opinion of Dr. Philbrick.

Perhaps no views are better worthy careful consideration than those of Dr. Philbrick, of whom the Commissioner of Education says:

It is acknowledged the world over that to him is largely due the excellence of the Boston schools. A thorough man of affairs, accurate and broad in his scholarship, in the fullest sympathy with American institutions and ideas, he not only watched and guided the Boston schools that grew under his hands for twenty years, but, by travels and studies in different parts of this country, and two visits to Europe—one of which included official duties in connection with the Exhibition at Vienna, and the other the special organization, care and management of the American Exhibition of Education in Paris in 1878—he had the vastest opportunities for extensive personal observation elsewhere in school matters, and for philosophical deductions therefrom. In his retirement, and with his accumulation of literature, of observation and of experience around him, he has consented at my request to prepare the following report on education in cities. * * * Every one will see that, to secure the fullest benefit to the millions interested in the wise administration of education in our cities, and the millions yet unborn to be affected by it, the writer of this report (is) possessed of rare qualifications for the undertaking. * * * I may add that I know of no more valuable study of city systems of public instruction than that presented by him.

[Extracts from Dr. Philbrick's Report on City School Systems of the United States.]

WHAT IS MEANT BY INDUSTRIAL EDUCATION?

It may be well, in the first place, to define what is meant here by the term industrial education, which is used rather loosely in the current discussions on the subject. Some writers use it in the same sense as technical education; better usage makes a distinction, however. J. Scott Russell, in his masterly book, "Systematic Technical Education for the English People," gives to technical education a broader meaning than that which belongs to industrial education, making it include all that education which teaches the knowledge required to fit men for some special mode of gaining their livelihood, and thus embracing the instruction of the highest professional schools, as well as that given in schools designed to form the handicraftsman of the humblest degree. Non-technical or general education, on the other hand, is that which has for its object to train and send into the world able men of matured intelligence and ripened powers, good for all the vocations of life and prepared to enter upon its duties with sound bodies, developed ability, and formed character; but it is not designed to communicate that special knowledge or to develop that special skill which fits a man for the particular calling or profession which he will have to choose as his life-work. This general education is the necessary basis and accompaniment of efficient technical education. Large education, broad development, a generous general training, are the best possible foundations of useful after-life, but they are only the foundations of the knowledge and skill requisite for professions and trades. This knowledge and skill it is the function of technical education to impart; it gives that special training which renders the educated man both self-supporting and directly useful to society. I willingly adopt the signification given to technical education by so eminent an authority, although my choice would be to call all that education which is not general, professional, after the nomenclature of the French pedagogy.

TWO DIVISIONS OF TECHNICAL EDUCATION.

Technical education in this comprehensive sense is composed of two tolerably well-defined divisions, the one being that which is concerned with the social professions and those relating to the fine arts, while all other occupations and pursuits requiring the application of science, art and manual skill are included in the other division. This province of technical education is what we mean by industrial education, which has for its scope to impart the knowledge and skill requisite for success in the three great departments of practical life—namely, agriculture, manufactures, and commerce; or, in other words, in producing the raw material from the ocean, the mines, the forest and the field, in converting these materials into useful forms, and in their transportation and exchange.

In its widest sense industrial education comprises not only all that a man does for himself, but also what is done for him by others to bring him nearer to perfection as a worker in any branch of industry.

In a more limited sense industrial education is that which is designed to impart the knowledge and skill requisite as a preparation for successful work in that department of practical activity which is concerned in changing the raw material into useful forms, or the manufacturing industry.

In former times knowledge and skill in industrial pursuits were almost exclusively acquired by means of apprenticeship. This held true not only of the mechanical trades, but of the liberal professions as well.

That state of things has passed away. An auxiliary instrumentality has been created by the demands to advance civilization; that instrumentality is the technical school, in its elementary, secondary and superior grades, and in its ever-increasing diversity of aim and purpose. Industries made but comparatively slow progress while they were carried on by persons whose instruction was limited to apprenticeship. Gradually, and in more recent times, the idea has made its way that the progress of an industry depends especially upon the degree of instruction of those who exercise it. This led to the establishment of industrial schools. The competition of industries is rapidly multiplying these schools, and from present indications these schools are destined to a development far beyond that as yet obtained in the most advanced community. Industrial education is of two kinds: first, that which consists in imparting a theoretical knowledge and the applications of science and the principles and rules of the useful arts, such as may be given in the class room and laboratory by the teacher and professor; second, that which consists in imparting the manual skill and the applications of science and the rules of the arts necessary to form the handicraftsman, of whatever grade. This is the education of the shop. The school for imparting this branch of industrial education is therefore primarily and essentially a workshop, supplemented to some extent with the theoretical training of the school-room and the manipulations of the laboratory. The considerations relating to industrial education here submitted must be limited to that portion of it which is imparted in schools, and, moreover, such schools as properly come within the scope of city school systems.

THEORETICAL KNOWLEDGE AND EDUCATION OF THE SHOP.

No school question is at present more agitated among us than that of making manual training a branch of instruction in the common school. Some extremists maintain that trades should be taught in the schools in connection with the common branches now required, so that when the scholar graduates he will be prepared to earn his living as an artisan on leaving school. Others, more moderate in their views, would not undertake to teach trades in school, aiming only to exercise the pupils in the use of the principal tools in working wood and iron. So far the different theories on the subject have been put into practical application only to a very limited extent. The two important practical questions in this connection which claim our attention are, first, what has been already accomplished in the direction of industrial education in our city school systems? second, what does experience indicate as desirable improvements to be undertaken in the department of industrial education? * * *

HANDICRAFT AS A BRANCH OF PUBLIC INSTRUCTION.—THE WORKSHOP IN THE SCHOOL AND THE SCHOOL IN THE WORKSHOP.

There are two modes of giving instruction in handicraft in schools: First, by annexing the workshop to the school for general education, whether elementary or higher. This mode is sometimes called the putting of the workshop into the school. Second, by establishing technical schools for apprentices, consisting primarily of the requisite shops, with appliances for giving the theoretical instruction applicable to the trade taught. This mode has been denominated the putting of the school into the workshop. * * *

Superintendent Marvel, of Gloucester, Mass., in referring in his report to an experiment tried in the schools of that city, remarks as to its results as follows:

"This attempt to combine intellectual and manual training will tend to dignify manual labor in the opinion of many young people just at that critical period when so many are now wasting opportunities for practical education in a vain endeavor to accomplish purely intellectual work for which they are totally unfitted. Recognition in the public schools that mechanical occupations are equally as important as the professions or as mercantile pursuits, and that the scheme of public instruction is broad enough to afford an education adapted to the needs of all classes of citizens, cannot fail to have a marked effect upon the succeeding generation. Boys and girls will deem it no less honorable to be found in the fields and workshops than in stores and offices, so long as they are engaged in legitimate and honorable occupations."

EXHIBIT O.

As supplementary to their investigations into the influence exercised by technical and other schools on the efficiency of foremen and other employees engaged in the principal industries of England, the Royal Commissioners secured the views in writing of a large number of manufacturers and other employers of labor upon the following points:

1. As to the influence on industries in which these employers were engaged of the science and art classes, and other sources of technical and general instruction that are available to apprentices, workmen and foremen; and 2. As to any means whereby such instruction may be rendered more useful.

Attention is invited to the appended extracts from a few of their replies, which, summarized, were to the effect that the schools are exerting a decidedly beneficial influence upon both the industries and the laborers through whom they are developed. These statements, coming as they do from men who are immediately engaged in the industries which the schools are designed to improve, are significant in their testimony concerning the direct and indirect value of technical education. They are from men who are likely to take a practical view of matters, and who are accustomed to decide upon the merits of things solely with reference to their economic results.

Notice should here be taken of the fact that English technical schools are not nearly so efficient as those on the Continent. Most of them have not been long in operation. Many are poorly equipped, and others badly managed. The best schools are the ones that have only lately been established, and consequently they have not yet had time to make their influence very extensively felt in the factories and shops. Besides this, it is only very lately that employers have taken interest enough in the schools to encourage and require their employes to attend the classes. Yet, notwithstanding all these adverse considerations, it will be seen that the opinions expressed in the letters referred to are decidedly in favor of the maintenance of science and training schools in industrial communities, and it is safe to predict that this sentiment will increase when the schools are made more efficient and have had a longer time in which to make results.

Only such parts of a portion of the answers are given here as relate to the influence of the schools upon industry.

[From Messrs. Kelson & Co., Iron-Workers, Leeds.]

"There is in our works a growing tendency, on the part of the hands employed, to greater intelligence and earnestness in the execution of the work allotted to the respective departments. The night classes at the Leeds Mechanics' Institute have long been an attraction to many of our young men."

[From Horrockses, Miller & Co., Cotton Manufacturers, London.]

"Many occupying leading positions in our employ owe their general competency to such advantages."

[From James Dixon & Son, Metal-Workers, London.]

"We are of the opinion that these schools have had from the beginning a very beneficial effect upon the foremen and workmen of our district, and that the amount of benefit that is accruing to the trade is increasing year by year. As the men who were old scholars are more intelligent and artistic workmen, their influence has a corresponding effect upon their apprentices, and induces them to send them to the schools."

[From Sir William Armstrong, Shipbuilder and Manufacturer of Guns, Newcastle-upon-Tyne.]

"The technical instruction given in the institution attached to these works has undoubtedly a beneficial influence on the industries in the locality. Our experience of the classes is that they not only develop thought and intelligence, but they also tend to foster studious and steady habits and to raise the tone of the students."

[From James Humphries & Son, Carpet Manufacturers, Kidderminster.]

"We have an excellent school of art, which has proved of great use in assisting to raise efficient draughtsmen and designers for our principal industry in this town—namely, the manufacture of carpets. Whereas, some years back, we were compelled to go to France and Germany for designs, we are now practically independent of other countries, as far as carpet-designing is concerned."

[From Thomas Tupling & Co., Carpet Manufacturers, London.]

"The influence of art classes in raising the style of design and workmanship cannot be too fully appreciated and encouraged."

[From Messrs. Hunt & Ruskell, Metal-Workers, London.]

"The influence of the science and art classes on our artisans is of the highest value, for they develop ideas of conception and taste that would otherwise lie dormant, and the training afforded by these classes raises the workman above the mere mechanical drudgery of his employment. We believe the same influence awakens a desire to cultivate refinement in the execution of his work, a sentiment that might have been lost but for the exterior educational aid afforded by the classes."

[From Messrs. Crosses & Wenkworth, Cotton Manufacturers, Bolton.]

"We regard the science and art classes carried on in Bolton as having conferred incalculable benefits on the industries of the town and district, and we look to them principally for the improvement in general knowledge of our workmen, and to fit them to become foremen."

[From J. K. Girdwood, Linen Manufacturer, Belfast.]

"At present there are only the classes held in the Workingmen's Institute and the School of Design available for workmen and foremen, both of which classes have been of great assistance to many of our employes attending them."

[From Edward Steegman & Co., Lace Manufacturers, Nottingham.]

"The influence of the classes is decidedly good, and the science classes are very well attended."

EXHIBIT P.

This and the preceding exhibit are designed to show the importance that employers attach to technical schools, and the comparative value of educated and uneducated labor.

In answer to inquiries concerning the value of educated labor lately proposed by General Eaton, United States Commissioner of Education, some very suggestive letters were received from employers and others interested in industrial pursuits.*

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* For these letters see the "Special Report on Industrial Education in the United States" (1883) already referred to.

EXHIBIT Q.

Mr. Mather wrote letters to several prominent educators of the United States, asking what effect the educational institutions with which they were connected were having on the commerce and industries of the nation. A few of the answers that he received are inserted here.

[Letter from Professor Trowbridge.]

SCHOOL OF MINES, COLUMBIA COLLEGE,
CORNER 49th STREET AND 4th AVENUE,
New York, October 30, 1883.

DEAR SIR: In answer to your question, "What effect is the School of Mines exerting on the professions and manufacturing industries of the country?" I will just state that my answer will apply, I am quite sure, to all the institutions in this country in which the applied sciences are thoroughly taught, and where, at the same time, proper instruction is given in the technical applications of these sciences to civil and mechanical engineering, and to the agricultural, mining and manufacturing industries.

The effects produced on these professions and industries are felt more and more each year, in the attainment of *greater economy* in production, as well as in new and progressive developments in engineering practice, and in the principal arts and industries. These effects are accompanied by, and perhaps are largely due to, a general diffusion of scientific knowledge among the people. All classes are becoming impressed with the value and importance of national scientific methods, especially when they learn that these methods harmonize with the results derived from experience and observation. The knowledge thus diffused is fast breaking down and destroying the false antagonism—formerly supposed to be radical and insurmountable—between *theory* and *practice*.

The business man is becoming a better judge and critic in matters of science and engineering applicable to his own affairs, while the farmer, the artisan, and even the common laborer, are learning that in proportion to their increased knowledge of true scientific processes their labor becomes more efficient; they can secure better results at less cost and with greater certainty than formerly.

You can readily understand that bringing scientific knowledge, even in its elementary forms, to bear on industry in this manner, promotes material progress and growth, and secures public confidence in enterprises or improvements which receive the sanction of well-educated scientific men.

For this increase and diffusion of knowledge and this public confidence we are indebted largely to our scientific schools, and to the men sent out from them. I need only suggest the direct influences which these men exert through their own labors when they are scattered through the country among the mines, the manufacturing and engineering establishments, and the engineering works in progress.

Very truly yours,

W. P. TROWBRIDGE.

MR. W. MATHER.

[Letter from Dr. Homer T. Fuller.]

WORCESTER FREE INSTITUTE,
Worcester, Mass., October 25, 1883.

MY DEAR SIR: In reply to your inquiry as to the effect of the training given at the Worcester County Free Institute of Industrial Science upon the industries of the country, it may be said that the school was not founded to create new industries, nor specially to build up those that were waning. It has helped to meet an increasing demand for men who were trained in both the theory and applications of science, and who, hence, could assist in developing and promoting enterprises requiring more than ordinary intelligence and skill.

It educates mechanical engineers, civil engineers, chemists and designers. Fifteen per cent. of its graduates are partners in business firms or superintendents of important business enterprises; 20 per cent. are foremen or draughtsmen, chiefly in shops for construction of machinery; 7 per cent. are skilled workmen in such shops; and about 20 per cent., comprising most of those trained in civil-engineering, are employed either in railway construction or in other civil-engineering work. Fifteen of them have filled responsible positions on a single railroad; six on another road. Besides these, the chemists have done good service in dye works and metal works, while about 10 per cent. of the whole number, including most of those who have given special attention to drawing and designing, have become teachers. Its graduates have usually quickly found employment, and some have been offered remunerative situations before completing their course of study.

It should be mentioned that this school is yet young, none of its graduates having been in practical life over twelve years, and the majority only four or five years.

The educational influence of the school has been considerable. Several other schools recently founded, or now projected, are adopting substantially its plans and methods of training. Such are the Rose Polytechnic at Terre Haute, Indiana, and the Miller School at Batesville, Virginia; and a committee of the Legislature of Georgia, after visiting the more important of the technical schools in the North in July last, reported a bill providing for the establishment of a State technical school, in which the course of training was indicated to be "as nearly as practicable like that of the Worcester Free Institute."

I am, etc.,

HOMER T. FULLER, *Principal, etc.*

WM. MATHER, Esq.

[Letter from Professor Greene.]

RENSSELAER POLYTECHNIC INSTITUTE,
Troy, N. Y., October 22, 1883.

MY DEAR SIR: I have to acknowledge the receipt of your kind letter of the 19th instant, containing a request that I send you a brief reply to your inquiry as to what is my opinion and experience of the effect exerted by the training in this institution upon the engineering works of this country.

It gives me great pleasure to comply with your request.

The Institute was the first school of its kind established in the United States. It was founded in 1824 by the late Hon. Stephen Van Rensselaer as a school of natural and applied science. Its founder, long a member of the Board of Canal Commissioners, had been actively interested and largely instrumental in the construction of our first great work of internal improvement, the Erie Canal, which

was completed in 1824. During the execution of this work there were no educated engineers in the country, and for this reason great difficulty was experienced in securing the services of persons competent to direct the necessary surveys, location and construction. Men were taken from various occupations and educated practically as the work progressed. Mr. Van Rensselaer thus had occasion to realize the pressing necessity of providing for the future requirements of the country, during the development of its vast and varied resources, a body of trained scientific men.

Engineering as a profession was unknown and, of course, unrecognized in the country. There were no railroads, no waterworks, no great bridges, and but few works of any description which could properly be called engineering works.

At such a time and under such circumstances the Institute was founded. During the 60 years which have elapsed since its foundation it has been closely identified with the marvelous growth and development of our country. From 1824 to 1840 its graduates largely became professors, geologists and manufacturers, a few only entering the field of engineering, for the reason probably that there was only a small demand for engineers.

With the introduction and growth of railways and other engineering works there came an increased demand for engineers, to meet which, in 1850–51, the course of study and practice at the Institute was modified and enlarged to meet existing and future requirements; and it then became exclusively a school of civil engineering.

About this time and for the same reason engineering courses were established in various colleges, and since that time many technical schools have been organized throughout the country, all based upon the same general plan, and all owing their origin to the rapidly growing demand for, and the more widely and generally recognized importance of, technical education.

At the present time there is scarcely a State or a Territory which has not its engineering or technical school.

The Institute has furnished many professors for these institutions. As a rule, however, the graduates of the Institute enter at once upon the active duties of the profession of civil engineering, in which very many have become eminent, not only as designers and constructors, but as managers of great railway and manufacturing corporations, while many others are growing up in various subordinate capacities, and are thus becoming fitted for the more important and responsible duties of the profession.

The field of engineering is rapidly widening, and the specialties of hydraulic, steam, bridge, mechanical, mining and electric engineering have been promptly entered upon and occupied by the graduates of all our technical schools. In all of these the reputation of the Institute is nobly sustained by its graduates.

I believe it is not too much to say that the marked success of every educated and thoroughly trained engineer, in any branch of the profession, creates a demand for, and supplies, three more having similar qualifications and for similar service.

Although our numbers are constantly increasing, there are times when we are quite unable to respond to applications for our graduates.

You, my dear sir, have had an opportunity to see something of our country, and to become acquainted with its enormous extent and resources. You have seen its public works, and have learned much in relation to its manufacturing and mining industries. You have also witnessed the activity and enterprise of our people. Wherever you have been, and whatever you have seen in our country, whether it be the great structure spanning the East River between New York and Brooklyn, the steel arch spanning the Mississippi at St. Louis, the Pennsylvania Railway (the model railway of our country), or the public works of Boston, New York, Brooklyn, Philadelphia, St. Louis, and other cities, you have witnessed, and can yourself bear testimony to, the effect of the training in our institution upon the engineering of our country. We cannot, and of course do not, claim exclusive credit for these or other important engineering works. We merely represent that the Institute has been and is represented in all of them. I therefore state, in conclusion, that experience justifies me in expressing the decided opinion that the training of the Rensselaer Polytechnic Institute, as well as that of other similar schools, has exerted a most marked and important influence upon the engineering works of America.

I am, etc.,

W. M. GREENE, *Director, etc.*

W. MATHER, Esq.

EXHIBIT R.

[Extracts from Mr. Mather's Testimony before the Senate Committee on Education and Labor, whose Report was published in 1885, and which contains much Valuable Information.]

In answer to questions by Senator Blair, Chairman of the Committee, Mr. Mather said that he lived in Manchester, England, where he was the owner of extensive machine shops, and stated that he had been an employer of labor all his life. The purpose of his visit to this country was to ascertain, on behalf of the Royal Commission on Technical Education, what opportunities are offered to the people of this country and Canada to acquire industrial training and technical knowledge. Mr. Mather further testified:

REASONS FOR THE APPOINTMENT OF THE BRITISH ROYAL COMMISSION.

The appointment of this Royal Commission to inquire into the technical education of all the countries in the world arose out of the fact that in England we have not many opportunities nor institutions which afford to our working-people, or even to our middle classes, the means of acquiring a knowledge of the sciences before they enter the usual occupations of life. We have felt for the last ten years very acutely, as you know, the competition which has sprung up in all parts of the world with English industries, and it has been supposed by some public men, and by large numbers of the community generally, that our manufactures of the simplest kind would for the future have to yield to a higher class of productions if we are to hold our place in the world as purveyors of clothing and the various articles which we have hitherto shipped from England. The countries of Europe have, of course, ceased to take from us gray cloth and the simplest forms of machinery, and in a hundred ways ceased to need our services in matters for which, twenty years ago, they were absolutely dependent on us.

In consequence of this we find it necessary to improve the taste in all articles we manufacture, and to bring to bear a higher knowledge of the scientific laws that underlie all the industries, and to educate our people into still greater skill—a skill derived from higher intelligence. Our opportunities

hitherto, in England, to impart this sort of knowledge to our apprentices, and to men who desire to learn after they have entered upon the ordinary duties of life, have been very few, and have been of a voluntary character. On the Continent of Europe industrial and technical schools have been in existence—in Germany, France and Switzerland particularly—for a considerable number of years, and the benefits accruing from these have at last invited our attention.

The industries of England have flourished chiefly, hitherto; upon the great demand which all the world has made upon us for our products, and on the facility with which, owing to the abundance of material, we have manufactured all our machinery and textile goods.

During the last ten years that demand, as I have said, has very much decreased, and we have now to pass on to a different kind of manufacture. Our people cannot respond to this higher demand made on them. We have not had the art schools or science schools to enable them to understand the laws or principles upon which this higher industry is based.

In order to meet this, we hope to establish in all our manufacturing districts certain institutions—you may call them technical schools—in which not trades shall be taught, but the science that underlies every industry shall be imparted to the children of workingmen, at the same time that they are somewhat trained in industrial skill to manipulate, to pass through and understand the operations which are necessary for the various kinds of manufacture that we desire to improve.

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MR. MATHER'S SHOP SCHOOL.

I will give you my own case. I have a number of engineer apprentices in my own works. I felt the necessity of having these young fellows employ the time more to their own benefit and profit, and also more to the interests of my concern, so we built a school inside the works and made it compulsory on every apprentice to attend that school during the evening two hours in the week. If they do not attend that school they are discharged from our employment; and this applies to all our apprentices.

TRADES UNIONS.

I am happy to say that trades unions with us have become part and parcel of our life. We have accepted them now as one of the proper societies for the working classes to form, and, conducted as they are by able and, I think, in the main, conscientious and respectable men, we have joined with them rather than separated from them. Employers of labor generally have lost that violent antagonism which, you know, existed at one time; the trades unions have moderated many of their demands, and whatever demands they now make, they at any rate make in more moderate language and in more polite ways. The capitalists and laboring population have both learned by experience, and, I think I may say, have come to see that none of the interests of capital or labor can be served when there is an antagonism between them. On the other hand, I think the laboring classes see that capital has certain difficulties and trials and experiences of which laborers know nothing, and by frequently comparing ideas, as we do under the arbitration courts that are sometimes established between masters and workingmen, a great deal of information is passed from one side to the other.

STRIKES ARE NOT VIOLENT.

The consequence is that our strikes now, though they may be long, are not violent; though they may be stubborn on the part of the men, who will not see that trade is in such a state that higher wages cannot be granted; or, on the other hand, on the part of the masters, who have their own stubbornness sometimes, and try to withhold from the laboring-classes the amount of wages they ought to give them when trade has improved. While these two positions will always, of course, to some extent, exist (for there will always be some obstinacy on both sides), yet, as a rule, violence and passion have departed from those disputes, and all questions are settled with good feeling.

In all trades, aside from the textile industries of our country, we have for many years been, for the most part, entirely free from strikes. In all engineering difficulties, disputes have been settled freely and without any ill-feeling. The engineer class with us are the most intelligent, and therefore the most reasonable. The engineer trades with us include pattern-makers, moulders, smiths, fitters, turners and directors of machinery—everything connected with machinery we call engineer trades.

LABOR DIFFICULTIES AVOIDED BY EMPLOYERS MANIFESTING A PRACTICAL INTEREST IN THE WELFARE OF THEIR LABORERS.

The building trades have a strike occasionally, but, compared with the number of differences that they settle by arbitration and conference, the strikes are not of much importance. They have had long-continued disputes from time to time, but, as I have said, there is no violence connected with them. After a certain amount of suffering on the part of the men (for, unhappily, it generally terminates that way with us), the difficulties are settled and they go to work. I think we have bridged over many difficulties by this simple remedy of arbitration. We have lessened the hours of labor, and have brought nine hours a day to be the standard, instead of ten hours a day. Employers generally have endeavored to show a sympathy with the social life of all our working-people by establishing provident dispensaries for their succor or assistance when either injured in their work or stricken down by disease. We have nurseries, institutions carried on under the superintendence of our wives, who go down into the lowest parts to find and aid distress. This is common to every manufacturing town in the country. The wives of the manufacturers, merchants, and employers generally have found that the lives of the people, after their hours of work are over, are matters of their highest regard for the sake of their own interests. Hence various institutions have been established by public subscription and are managed by the manufacturing class for the benefit of the laborers.

You may readily understand that any virtuous and good act brings its own reward. That is an axiom that we have all accepted. But when I spoke of their interests, I meant that from quite a material point of view, leaving out the philanthropic motives and the higher relations of men, and speaking of it merely as a matter of business.

MATERIAL INTERESTS OF EMPLOYERS ARE THUS ADVANCED.

Wherever the employers of labor have manifested this interest they have found it to be of advantage in a business point of view. Whatever difficulties might arise between them and their employes in consequence of wages have been more readily adjusted, and, at any rate, the motives of the manufacturers are not misunderstood. The men only require to be convinced of the exigencies of trade, and to see that the thing which is stated to them is really true, to induce them to yield. This sympathy, this endeavor to elevate and improve the working-classes all round, sometimes by individual manufacturers, at other times by manufacturers combining together to make a district the centre of some means of reaching and improving the working-classes, is having the most excellent effect.

COFFEE-HOUSES, PUBLIC PARKS AND MUSICAL ENTERTAINMENTS.

For example, the establishment of coffee-houses, all over our cities, to form a sort of antidote to the public-house, to give workingmen a nice room in which they can meet their fellows and sit in comfortable chairs and have a smoke and a talk together, and an opportunity to take this harmless beverage and creature comforts of that sort, to the exclusion of spirituous liquors—all that has had a great effect. The public parks have also helped. The musical entertainments in the open air during the summertime—many of them encouraged by our corporations and supported largely by the employers—all that work is well-directed outlay for the enjoyment of the people.

HOURS OF LABOR PER WEEK.

The reduction of the hours of labor from sixty hours to fifty-four has allowed all the working-people to have a holiday, leaving their work on Saturday at 12 o'clock. It gives them an opportunity to make their purchases in the daytime, and to take their children out into the parks and enjoy the fresh air. The working-hours are such that the workingman has practically got daylight all through the year for his work, and then during the summer months, of course, there are long evenings of daylight, and the half hour less labor at each end of the day gives the workingman an opportunity to wash, and covers the time when he would be going home, and is a great consideration to him. In consideration of this extra time allowed for recreation, we find that men are attending reading-rooms more than they did.

LIBRARIES AND READING ROOMS.

We have free libraries and reading-rooms established in each ward or district of our towns. If the ward is very large we divide it into districts and establish a reading-room which does not cost much money (three or four thousand pounds), and there we keep the papers of the day and scientific and literary periodicals and some standard books, and we find that the working-people are appreciating these advantages just in proportion as they get more time to devote to them. They have more leisure now, and many take advantage of their time to pursue some studies.

EVENING SCIENCE SCHOOLS.

And because of this, we think our evening science schools, which we are endeavoring to improve, will be better attended, and we shall therefore get some science and art teaching into the adult working-classes who have already begun their life-labor, who have almost always the desire to become better nformed, and will in this way be able to satisfy that desire.

HOURS OF LABOR IN AMERICA.

If you will allow me to, I should like to make another remark as a result of my observation in America. I do not wish to say anything to intensify differences of opinion, but, having said it to several employers of labor, it may not be inappropriate to say it here. I believe that all American working-people have greater activity, greater nervous energy than our people have, and I believe they do more work, and can do more work, from that spirit of intense desire which they have to accomplish something, to accomplish more, even, day by day, than they have done before. This is the spirit of your people. They work harder while at work, and I therefore say that nine hours of labor here, with the intensity of diligence which your people display, would, I think, count for more than ten hours of our people's work. Undoubtedly the condition of the working-classes in this country is superior to ours, all round. The very fact that you have food just as cheap as we have it—in some places they say it is cheaper, but at any rate it is just as cheap as our working-people enjoy—that you pay wages varying from one-half as much again to double as much again for similar employment; that you have or have had, hitherto, as I think, more constant employment than our people have, and therefore the aggregate earnings in the whole year are greater than they are with our people—all these indicate that there is more purchasing power in the hands of the American workingman than an English workingman enjoys.

HIGH RENTS IN AMERICA.

The one subject which strikes me as being very difficult to comprehend, and most oppressive, I think, upon your working-people, is the enormous amounts they pay for house-rent. I do not think I overstate the case when I say that rents are double, all through this country, for the same degree of comfort, that they are in England. That is so even in Pullman City, which is a model city. It has always struck me as being a very remarkable and almost unnatural condition of things that in a country where there is so much land, and where the resources of the people are so much greater, and material therefore ought to be so cheap, the habitations of your working-people cost so much. It is certainly an indisputable fact that rents are double here what they are in England.

In this country waste of raw materials is the normal condition of things. You waste your forests, your metals, your food and your drink There is so much waste here that it is not noticed.

All the institutions for the aid of the working-people are kept up by the employers—all our hospitals and dispensaries—to give cheap medical advice and cheap surgical aid, and relief in time of need. We have workingmen's clubs established by philanthropic people; we have coffee-houses where the workingmen can come and read. Into these, members of the committee come from time to time, and take an interest in the young people.

I think what you require here is a larger interest in the working-classes by your wealthier people. You require more institutions for their intellectual enjoyment, for their entertainment and their recreation. You require less hours of labor, certainly.

I think you ought to reduce your hours of labor to nine—it would be for the benefit of the whole country, employers and employes—so as to give a full, solid half-holiday each week for the entire mass of the working-people. They would enjoy family life more, and would have less temptation to indulge in vicious habits.

INDUSTRIAL TRAINING SHOULD BE INTRODUCED INTO THE PUBLIC SCHOOLS.

Then, in your common-school system, by including industrial education side by side with intellectual education (and it would not hurt intellectual education, but would help it), you would have a larger number of people who would be willing to go out into the far West, and, meeting the forces of

Nature, subdue them in a territory that is apparently unlimited and as rich as it is boundless. All that spirit would be evoked by these simple changes, which would be very easy to make. It would only require probably the resolution to do it, and it would be done.

COMPARISON BETWEEN THE CONDITION OF AMERICAN AND FOREIGN WORKMEN.

In all other respects the working-classes of this country are infinitely better situated than any people abroad. They have in their form of government no hindrances of any kind, either from tradition or feudalism; they can acquire land easier—it is almost given away in many parts of this country. They have an equality among themselves and their foremen and managers that you do not see in any part of the world. I am particularly struck by the respect which the managers and foremen here seem to have for their workmen, the civility they show them; all of these are advantages to the workingmen, apart from their civil rights, which, of course, are universally admitted here; all these make up a social condition superior to anything we have in England. And if the working-people were only by their habits to show that they were capable of taking the advantages offered them by Nature and by your free institutions, they ought to be the happiest and most prosperous people in the world. Government need do nothing more for them, I think; but society requires to do a great deal more for them.

PUBLIC OPINION SHOULD BE DIRECTED TOWARD THE AMELIORATION OF THE CONDITION OF THE LABORING CLASSES.

I have heard a gentleman say here that corporations were not distinguished for their sympathy. That is true; and that is why I point out that society in America, in all the great centres of industry, has a duty laid upon it that I think it is not performing in the full sense of its responsibilities. In these great corporations the shares are held, I presume, by wealthy persons, representing probably the culture of your cities, and probably occupying public positions. It would be a very simple matter for any of those corporations to appropriate, by their shareholders, from year to year, such amount of money as they might wish to appropriate for the benefit of the working-people. And if public opinion in this country were directed toward the amelioration of the condition of the working-classes all around, it would not be an uncommon thing for certain sums of money, probably every year, to be given for their benefit. That is not uncommon with us. We are tending somewhat ourselves, you know, to turning all our concerns into joint-stock companies; but I am very happy to be able to say that we often find that spirit of humanity among our corporations—not so much, perhaps, as with individuals, but there is coming, more and more, to be an acknowledgment of the fact that any employer of a large class of people is bound to regard those people on the social side as well as the industrial side.

EXHIBIT S.

[Extracts from an Address on Technological Instruction, by Philip Magnus, Secretary and Director of the City and Guilds of London Institute.]

Workmen, generally, make a great mistake in taking a very narrow view of their own educational requirements. Instances of this are continually coming under my notice. It is difficult, for example, to make them understand that a knowledge of intimately associated and cognate branches of their trade is likely to prove serviceable to them; that in order to become efficient foremen it is necessary that they should possess an intelligent and comprehensive acquaintance with the entire area of the work in which they are engaged. It is partly to correct the cramping influence of the extreme division of labor that technical instruction has become necessary.

Speaking from my own experience, I should say that workmen generally care to learn in the school very little more than they might learn in the shop; they only want to learn it more quickly. This desire of workmen to learn those parts only of a subject which seem to them to be intimately connected with their special occupation reminds me of a fact told me by a medical friend, that among his students of anatomy was one who expressed his decided unwillingness to dissect the abdominal cavity, because, as a surgeon, he intended to devote himself exclusively to diseases of the eye. This narrow view of the scope and objects of technical education needs to be steadily and persistently discouraged, and it is one of the objects of this college to bring home to the workman the advantages of a wider and more comprehensive system of instruction.

A similar difficulty is experienced in inducing adult artisan students to attach sufficient value to a knowledge of the elementary principles of the sciences bearing upon their industry. This is due partly to the method of science teaching commonly adopted, which does not distinguish between the requirements of school-children and of adult workmen, and partly to the fact that such students are too impatient to see the immediate applicability, at each successive stage, of the knowledge they are gaining to their particular work. It is possible that the fundamental principles of science are not always presented to the artisan student in as attractive form as they might be, and that he is not made to see, at a sufficiently early stage, the connection between the instruction he is receiving and the occupation in which he is engaged; but of the value and the importance of this elementary knowledge as preliminary to, and as an essential part of, technical instruction, we must take care never to lose sight.

These and other difficulties will doubtless be found to gradually disappear in the training of young apprentices, who will constitute the workmen of the future, and whom, in the interests of trade, quite apart from the material advantages which they themselves may derive from such instruction, it is most desirable to carefully educate. In Belgium, and in some parts of Germany, where technical teaching is better systematized than in this country, the class-rooms, in the evening, are filled with young students who attend five or six nights a week and follow the several courses of instruction in the order in which they are recommended to them; and, in the hope of being able to introduce a somewhat similar system into this college, courses of instruction have been arranged, adapted to the requirements of apprentices engaged in various industries, but affording, at the same time, an education in the true sense of the word. These curricula have been drawn up with special reference to the educational wants of the mechanic, the electrician, the metal-plate worker, the cabinetmaker, the carpenter, the bricklayer, the plumber, etc., and are intended to supplement without interfering with his workshop training.

In the ordinary teaching of pure science the preliminary stages of instruction are such as afford, or are intended to afford, the best basis on which the superstructure of higher knowledge can afterwards be raised, and where the pupil has a long course of study before him, to which he can devote himself before being required to apply this knowledge to any special art or industry. No better method of instruction can be devised.

But the case is different where the pupil's period of study is necessarily limited, and is not long enough to enable him to attain to that higher knowledge which would justify the time spent in preparation for it. Indeed, in this respect, the practical educator may take a lesson from the builder, who adapts his foundations to the superstructure to be raised upon them. This question of time is an important factor in the consideration of all schemes of technical instruction necessitating the early specification of the student's work. For we may take it for granted that the pupil requires not only a knowledge of the principles of science and of the details of practical work, but the ability to apply the one to the other; and for this reason it is essential that theory and practice should be combined in his instruction, and that both should have reference to his particular work.

PRACTICAL CHARACTER OF THE INSTRUCTION.

In this college all the subjects of instruction will be taught, as far as possible, with reference to the career or occupations of the students; that is to say, the teacher will keep steadily before him the purposes to which the student will apply his knowledge in the instruction which he gives him. Indeed, the technical teacher ought to be so constituted as to be able to keep one eye on the general principles of science, and the other upon the industry which his pupil intends to follow. Instruction of this kind must overlap ordinary science teaching and the teaching of a trade, and must yet be distinct from either. Between the ordinary, or the scholastic, teaching of the elements of physics, and the instruction, for example, that might be given to a novice in the manipulation of a telegraphic instrument, there is a wide difference; and it is within this difference that a technical teacher is called upon to do his work. So, too, between the teaching of Euclidian geometry and the rules that would be given to an apprentice for the construction of a particular kind of joint, or the cutting out of a sheet of metal to a given pattern, lies the border-land for technical instruction in the application of geometry to joinery and to metal-plate work.

Speaking generally, the method of teaching science in this college will be based on the well-known educational principle that all teaching should proceed from the concrete to the abstract, from the known to the unknown. The student will be brought into contact, first of all, with the actual working machine, and he will then proceed to analyze it into its different elementary parts, and to deduce the laws of their action. In this way the principles of science will be derived from the mechanical contrivances exemplifying them, just as the laws of growth and decay are inferred by the student of biology from the observations of living animals and plants. This method of science teaching has been tersely described by Professor Ayrton as the analytical, as distinguished from the synthetical method; and it is satisfactory to know that in this college it will receive a fair trial. To the adult student the advantage of this system of instruction must be plainly manifest, for he, being already familiar with the general character of the machinery he uses, will arrive at a knowledge of the abstract principles of science by a natural and easy method of inquiry into the causes that explain the processes he sees; and, apart altogether from the material advantages he may derive from this higher knowledge, he will be enabled to reach the state of happiness ascribed by Virgil to the similarly educated agriculturists.

"—*qui potuit verum cognoscere causas.*"

It is scarcely necessary to add that the teaching in this school will be essentially practical; that more will be done in the laboratories, in the drawing-rooms and workshops than in the lecture theatres. Indeed, it may be rather said that the lectures will form a commentary on the practical work than that the practical work will servo only to illustrate the lectures.

THE MAIN PURPOSE OF THE INSTITUTE CLEARLY STATED.

It must be remembered, in considering this difference of method, that the main purpose of the teaching to be given in this institution is not to make scientific men, nor to train scientists, as the Americans call them, but to educate technikers, as the Germans say; to explain to those preparing for industrial work, or already engaged in it, the principles that have a direct bearing upon their occupation, so that they may be enabled to think back from the processes they see to the causes underlying them, and thus substitute scientific method for mere rule of thumb. It is almost superfluous to remark that instruction of this kind can be given by those only who possess a wide and deep knowledge of their subject, and a full and accurate acquaintance with the practical and commercial details of the industry or trade to which their teaching refers. Indeed, it is now generally recognized that technical teachers must be familiar with the processes of the factory or workshop. Teachers of this kind the President of the British Association must have had in view when, in his opening address at Southampton, contrasting them with the ardent students of Nature, the "High Priests of Science," he said: "It is not to them that we must look for our excellence and progress in practical science; nor must we look for it to the rule-of-thumb practitioner who is guided by what comes nearer to instinct. It is to the man of science, who gives attention to practical questions, and to the practitioner, who devotes part of his time to prosecution of strictly scientific investigations, that we owe the rapid progress of the present day." Such men, of whom the writer himself is so illustrious an example, are difficult to find; and yet the progress of technical education in this country depends upon their supply.

The teacher who is to inspire confidence in his artisan students must address them in the language they understand, and must show that he is not beyond appreciating practical difficulties which occur to them in their daily work. Dr. Siemens further tells us that "theory and practice are so interdependent that an intimate union between them is a matter of absolute necessity for our future progress"; and certainly none are more alive to the truth of this proposition, as regards educational progress, than artisan students, for it is to them a constant source of regret that they are unable to see the relation of scientific truths, as they are generally imparted to them, to the work in which they are engaged; and in this complaint, which is so often heard, is found the protest of workmen against the divorce of practice from theory in the instruction which they frequently receive. With the view of indicating the requisite qualifications of the technical teacher, the Council of this institute have inserted in their programme of technological examinations a paragraph stating that persons having a practical acquaintance with their trade, acquired in the factory or workshop, and possessing, at the same time, such knowledge of pure science as enables them to teach under the Science and Art Department, will be registered as teachers by the institute.

Of the four departments into which the college is divided, that of electrical engineering promises, for some time at least, to be the most attractive to students. The applications of electricity to telegraphy, telephony, illumination, machinery and locomotion are among the most recent of the practical developments of science, and seem to afford a glimpse, if nothing more, of the wider field of invention which is yet to be explored. The appetite for wonders grows with what it feeds upon, and never

before, perhaps, was the world more willing to believe in the possibilities of science than now. This universal credence almost constitutes a new faith. The numerous discoveries fetched within the last few years from the seemingly boundless world of physical science verify and give a special significance to Cicero's words:

"*Omnibus fere in rebus, et maxime in physicis, quid non sit citius quam quid sit, dixerim.*"

Although electricity may be regarded, just at present, as the most popular of the sciences, the discoveries which have recently been made in other branches of knowledge are scarcely less important. The skill and the inventive power of the mechanism have been called into requisition with every advance in physics and in chemistry. Indeed, it is only when the inventions of physicists and chemists are capable of being adapted to machinery that these inventions can be said to be practically serviceable. The great discoveries which have recently been made in chemical science, in the application of which to industrial purposes the Germans and the Swiss have left us so far in the rear, are among the causes that have given rise to the demand in this country for the technical instruction which the City and Guilds of London are engaged in providing. It may reasonably be supposed that many of the students of this college will entertain the laudable ambition to have their names enrolled among those who have pushed discovery one step further, and have added something to the sum total of human knowledge; and it may be encouraging to these students to be told that they will here receive a preparatory training that should help to place the power of discovery within their reach. For discovery in science, like design in art, does not depend entirely upon, although it is greatly aided by, inspiration and genius. Any one who is carefully trained in the methods of research, who is shown the processes by which the system of organized knowledge, known as science, has been gradually built up, may reasonably hope to unravel fresh secrets of Nature, and to add something to our knowledge of what is or may be. Except, perhaps, in the region of chemistry, it is not the masters of acquired knowledge, the professors of abstract science, but rather those who have made science minister to art—practising first and then calling theory to their aid—who, as discoverers, have exerted most influence upon the material progress of the world, and have chiefly assisted in the development of its trade and commerce.

EXHIBIT T.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—SOCIETY OF ARTS.—EDUCATION FOR RAILROAD ENGINEERING.

The 351st meeting of the Society of Arts was held at the Institute of Technology on Thursday evening, Oct. 28, President Walker in the chair.

After reading the records of the previous meeting, the President introduced Mr. C. D. Jameson, of the Institute, who read a paper on "Railroad Engineering Education."

Mr. Jameson said: "The duties of the first railroad engineers were much more general than those of the present engineers. They located and built their railroads, designed their locomotives, rolling stock and bridges, and when completed managed the road with success, and this without the aid of experience or precedent. Usually they were men who had had no early education or training in railroading, but possessed an indomitable will, unlimited patience and a good stock of common sense.

"We undoubtedly do things more quickly now than then, and in many respects do them better; but this is due to the fact that we naturally profit by their experience, and also at the present time no one man does the whole of anything, hence he can do his particular part better.

"In many branches, however, we have made little, if any, advancement. This is particularly the case in the matter of location where we seem to have copied the earlier engineers in their errors, but not in their habits of careful observation and study.

"The majority of our railroads are uneconomically located, and not only was the first cost of construction more than it ought to have been, but the loss in the operating expenses is enormous, and increases with increasing business. This loss is not, in the majority of cases, due entirely to the engineering profession, but to the mistaken policy on the part of the management of the railroad companies.

"The expenses of the engineering parties on preliminary work and final location are very great, and for much of this expense the management can see no direct return, and there seems to be an idea abroad that most of the money spent in this way goes for theory and is of very little practical use to the company. Therefore the salary of the locating engineer is comparatively small, and his ability is frequently small in proportion. The number of his assistants is kept as low as possible and the result is inferior work. The vital principles upon which the economic location of a railroad depends are not considered at all, or, at the most, in a very slight degree, and the smaller details upon which, to a great extent, depends the ultimate financial success of the road, are left entirely out of account.

THE CONSTRUCTION ENGINEER.

"After the road is located the management secures the services of the best construction engineer possible. This is as it should be; but no matter how great may be the abilities of the construction engineer, or how much he may save in overcoming the defects in location, still the greater part of the money merely passes through his hands as a paymaster, having been actually expended months before by the locating engineer.

"In order that the railroad engineer of the future may be thoroughly competent, both in the 'theory of economic location' and in the details connected with the work in the field, too much attention cannot be paid to this branch of education.

"We are in an age of specialties. The engineering profession has been subdivided, so that we now have civil, mechanical, mining, hydraulic, sanitary, bridge and railroad engineers. In order to reach distinction a man must confine himself to his specialty, and if that be railroading, his time either as a student or as a man in active work will be amply filled in keeping pace with the age.

COLLEGE TRAINING FOOLISHLY UNDERRATED.

"There seems to be a tendency among certain classes to sneer at an education, considering the time that is spent at college wasted, and that it might have been spent to much greater advantage in actual work in the field. Many instances are cited by these people in corroboration of this belief of persons who have risen to the head of their professions by their own exertion, without the aid of a college or technical education, and also of a large number of men who having graduated from our finest schools, have accomplished nothing. The reason for this is not that these unsuccessful men lost anything by

going to college, but they were greatly inferior in energy and ability to the others. Colleges do not profess to make brains, but simply to teach the man to use what he has to the best advantage, and the man who is successful without a college or technical education would, with this aid, have found the path to success much easier and shorter.

"In the years which intervened between the first railroad engineers and those of the present they were considered a necessity in locating and building the road only. The road was then turned over to business men to manage. As long as the roads were small, and the repairs and renewals slight, this worked well. As the number of roads increased, and long lines and systems begin to be formed, the increase of traffic demanded a large increase in the size and weight of the locomotives and rolling stock; this in turn necessitated renewals and additions to the roadbed and track, the replacing of the old bridges by new and heavier ones. This reconstruction in the form of renewals will never cease, and with it all the railroad companies have come to see the necessity of a permanent and reliable engineering corps. Thus the field of work for the railroad engineer has broadened from the transient work of locating and constructing the road to permanent positions on established roads, where there are abundant opportunities of making good use of his ability. But in order to take advantage of all these opportunities there is need of a much broader education in what w emay call 'railway science,' which includes many branches as yet very little taught in our technical schools.

SPECIAL COURSE IN RAILWAY SCIENCE.

"Let us now look at some of the items that should be included in a course of instruction in 'railway science,' or, as it is commonly called, a 'special course for railway engineers.' The length of the course should, if possible, be five years instead of four. The first two years should be devoted to laying a firm foundation in the general studies, particular attention being paid to mathematics, chemistry and physics in their more elementary forms; the third year to the general study of civil engineering, and the last two years to a special study of railroads in all their branches. The third year's course should contain thorough instruction and practice in the field work of the railway engineer, in both location and instruction. When the weather will permit, the field work should be pushed even to the point of sacrificing some of the work in the class-room. The field methods should be taught exactly as they are now used in the best practice; the same terms used, the same organization of parties, and, most of all, the same discipline and strict attention to business. The greatest possible attention should be paid to the subject of location in all its details in the field, and when the student has mastered as far as possible the principles that govern a railroad location in regard to the geography of the country and understands the actual work of putting the line on the ground, then, and not till then, should he be instructed in those finer details and principles of the work called the 'Theory of Economic Location,' and upon which the true location of a railroad depends.

"This 'Theory of Economic Location' should be taught in the last two years. Also there should be given a course of instruction in every branch of railroad construction, which should contain an amount of hydraulic and sanitary engineering sufficient to enable the person to build and maintain stations, shops, etc., and the proper handling of all the water that may be encountered in the construction and maintenance of the road; the 'maintenance of way' in all its details, both in theory and practice; the proper management and economical distribution of large and small gangs of laborers; railway management as it applies to the operating of the road, such as internal management of the separate departments and their relations to the general management; the making up and running of trains; running and repairs of locomotives and rolling stock; station and terminal service; the relation between the railroad and the public; the financial management as to bonds, stocks, leased lines, consolidations, pools, etc.; and all the questions of railway transportation, legislative interference and State ownership.

"In the instruction in any branch of engineering the one thing to be kept prominently before the student is economy of design and construction. It is not enough to be able to design and construct a bridge of a certain length which shall safely hold up a given load, or a station that shall accommodate a given number of passengers and trains, but this should be done at the least possible cost.

PRESENT COURSES OF INSTRUCTION ANTIQUATED.

"If a person examines the courses of instruction in the different branches of engineering in the various technical schools in this country, he will be struck with the antiquated ideas and methods that still prevail in a majority of them. With but one or two exceptions there is no instruction given in railroad engineering proper, and the merest outline of the principles of location and construction. There are undoubtedly some reasons why the schools are so much behind the times, and one of the most common and at the same time the most serious is the lack of money. Another is the low standard of admission, in consequence of which the whole of the first year is occupied in teaching what ought to have been learned before entering. The standard of admission is often lowered to attract students, but it is a suicidal policy and soon ruins the reputation of the school.

NEED OF LIBERAL ENDOWMENT OF ENGINEERING SCHOOLS.

"Every school should have an endowment large enough to pay all salaries and running expenses without depending in the least on the tuition of the students. Students should not be admitted until they are eighteen years of age, so that they will be able to fully appreciate the advantages offered them.

"Still another reason is in the fact that the faculties of many of the technical schools have allowed themselves to get into ruts, from which it is difficult to move them. With the exception of the first, these reasons may be classed under the head of bad management, and the trouble can be easily corrected.

THE EQUIPMENT NEEDED.

"Every advantage should be placed at the disposal of the student. All the apparatus necessary for experiment of every kind should be provided; a good library containing every book of worth bearing on the different subjects; a good, quiet reading-room where all the engineering periodicals of the day are accessible. The student should be encouraged to do as much reading from a literary standpoint as possible. It teaches him how to think and to express his thoughts in a clear, logical and grammatical manner.

"He should be taught habits of application and the power of being able to concentrate the whole mind for the time being upon whatever work he has in hand. In other words, he should be taught to

study so that when he leaves he will not only be able to profit by his own experience as it comes slowly, but, what is far better, to profit by the experience of others, and thus at once advance to a point which it would take him ,ears to teach by himself.

"During the years spent at the Institute the student should examine as much as possible all engineering works that can in any way interest him while in process of construction.

"In conclusion, let me say that the student should be so drilled that when he graduates he can have not only the diploma of the school, but, what is of more importance to him, can accept any position in his profession that offers, prove himself of use, and therefore a necessity to his employer, and earn a living for himself."

The paper was followed by a lengthy discussion, in which President Walker, Professor Swain, Hon. J. A. Dresser, Mr. George R. Hardy, and Mr. Dwight Porter took part. The meeting adjourned with a vote of thanks to Mr. Jameson.

As already stated, exhibits from "T" to "Y," inclusive, are given in chapter V. of this volume of this Report. The final exhibit marked "X," as given in the report by Dr. Barnard, was designed to show the actual want of relation between the public educational system of the City of Baltimore and the Johns Hopkins University; in contrast with the possible relation that, in Dr. Barnard's judgment, ought to exist! This exhibit, with its graphic showing, presents a very interesting, suggestive and plausible ideal of the relation that might be borne between the public free schools of a great city and a high class university. As such it follows here, whether it secures any practical result or not, the plan reflects credit upon the humanitarianism of its lamented author.

EXHIBIT X.

This exhibit contains a graphical representation of Baltimore's school system as it is and as it should be. It will be seen by the first diagram that the provision for industrial training is practically nothing, and that there is no connection between our school system and the University. But little more than one-half the children who enter the primary grades ever pass into the grammar grade. Some of the others enter private schools, but very many of them quit school to reinforce the ignorant, the vicious, and the criminal classes. One reason of this is that their parents do not see much in the grammar-school course that will be of use to children who have to make their living by manual labor. In addition to the subjects now taught in the grammar grades, there ought to be practical instruction in industrial drawing, experimental science, and physiology and hygiene. Instruction should also be given in the grammar grade to girls in cooking and sewing, and to boys in the use and care of tools. With such additions to the grammar-school studies, more boys and girls would be induced to complete that course, and thus be fitted for high-school duties. Those who from inclination or force of circumstances left school after completing the grammar-school course would enter upon their life-work with a fair amount of elementary education and with habits of study sufficiently well fixed to make self-improvement possible. The grammar school should fit boys and girls for either a literary or an industrial high-school course, and for such art schools as the Maryland Institute.

The literary high school fits young people for commercial pursuits, for law, medical, or theological studies, and for college courses. It is certainly only fair that the school system should make equal provision for the preparatory training of those who are to become mechanics, architects, engineers, etc., and thus fit them for the higher training that is afforded in purely technical schools. The literary high schools of Baltimore cost $75,000 a year, while only $12,000 a year is allowed for industrial training in the Manual Training School.

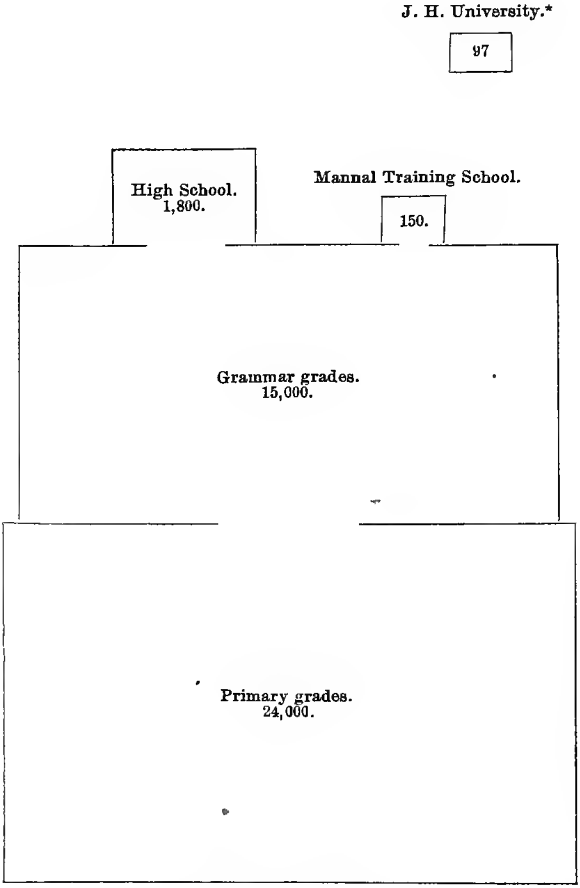
The literary high-school course should continue as it is, with some slight modifications. An industrial high school should be provided for on a scale as large as the literary high school now is. The course of study should include manual training, industrial drawing, applied science, mechanic arts, book-keeping, and history, government, etc., together with some literary studies. There ought to be a close connection between the literary and industrial high schools, so that students could change readily from one to the other. Some of the classes might be in common with mutual advantage.

The Johns Hopkins University should be considered as a part of the Baltimore school system, and its crowning glory. To maintain this position it should afford instruction in applied, as well as in pure, science.

BALTIMORE SCHOOL SYSTEM.

Drawings representing by areas the attendance as it is and as it should be:

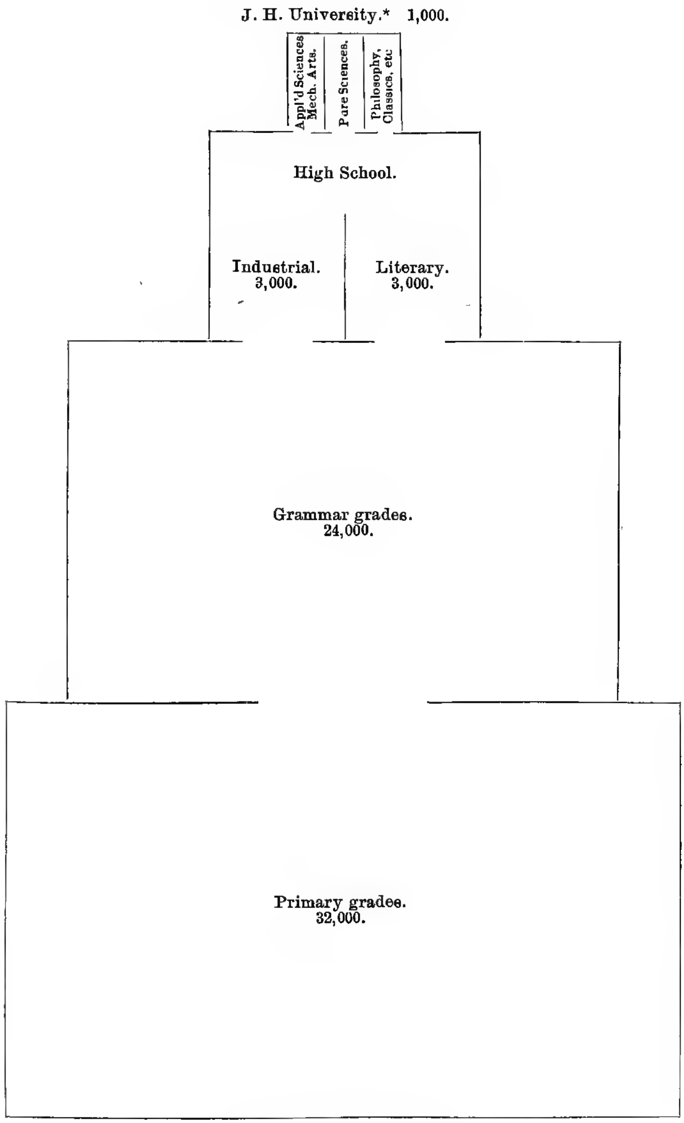
AS IT IS.



Scale 4,000 to square inch.

* The diagrams show the University in its relation to the city school system, without regard to other sources from which students are drawn.

AS IT SHOULD BE.



Scale 4,000 to square inch.

* See footnote on previous page.

APPENDIX Z.

PAPERS RELATING TO THE U. S. COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS.

I. Introduction.

II. The Land Grant Laws of the United States.

III. Historical Statements concerning Passage of the Land Grant Law of 1862. Accounts of the successful efforts, in promoting the passage of the above law, made by Dr. Amos Brown, of New York State, and by Dr. Evan Pugh, of Pennsylvania.

IV. Historical Addresses delivered at the commencement of the Massáchusetts Agricultural College, June 21st, 1887, the 25th Anniversary of the Passage of the "Morrill" Land Grant Law of 1862.

V. Paper entitled Agricultural Education in Bavaria, by Professor R. B. Warder.

VI. Address on Technical Training, delivered by Professor John Hamilton, on the occasion of the opening of the New Mechanical Department Building, Pennsylvania State College, February 10th, 1886.

VII. Farewell Address by Bishop Haygood, at commencement of Claflin College, South Carolina, in 1890.

APPENDIX Z.

PAPERS RELATING TO THE U. S. COLLEGES OF AGRICULTURE AND THE MECHANIC ARTS

I.

INTRODUCTION.

The papers which make up this Appendix, all relate, more or less directly, to those Colleges of Agriculture and the Mechanic Arts, which arose in obedience to the creative fiat of the American Congress.

As these colleges were thus the direct outcome of the laws passed by the Congress of the United States, it seems fit and proper that copies of these three creative laws should be here placed.

The immense power for good which the act of 1862, has developed, lends interest to everything throwing light upon its passage. The historical paper, furnished by the courtesy of Professor Chickering, which recites the important work accomplished by the late Dr. Amos Brown, of the State of New York; and the data elsewhere obtained showing how earnestly the late Dr. Evan Pugh, of Pennsylvania, cöoperated in the efforts made by educators to perfect and pass this epoch-making law, can hardly fail to interest every reader.

The extracts from the striking addresses delivered at the commencement of the Massachusetts Agricultural College in 1887, on the 25th Anniversary of the passage of the so-called "Morrill Act of 1862," possess both historical and contemporary interest.

The careful and exhaustive paper which follows, by Professor Warder, setting forth the thorough system of State education in Agriculture as illustrated by the Kingdom of Bavaria; is full of information and suggestion for American educators and law makers.

The admirable statement by Professor Hamilton, of what the new education is, was made on the occasion of the opening of a building for this new Department in the very college of which Dr. Evan Pugh,—who, as is set forth in a previous paper, so earnestly cöoperated in the efforts for the passage of the law of 1862,—was formerly the President.

The final paper, the farewell Address by Bishop Haygood, treats of one of the most momentous problems of the new era in American development.

An "Introduction" at greater or less length, precedes each of these papers.

II.

The Land Grant Laws of the United States.

As often in the course of this Report, and inevitably in the accounts given of the different State Institutions which have received the benefits conferred by the laws authorizing the National Land Grants, these laws have been constantly referred to; it has been thought advisable to include in this Appendix, which contains articles particularly related to these colleges, a copy of the three laws popularly known, from the names of the members of Congress in charge of the Bills, as the "Morrill Act of 1862"; the "Hatch Act of 1887"; and the "Supplementary Morrill Act of 1890."

The Laws Enacted By The Congress Of The U. S. Relating To The Colleges Of Agriculture And Mechanic Arts.

The Act of 1862.

An Act Donating Public Lands to the Several States and Territories which may Provide Colleges for the Benefit of Agriculture and the Mechanic Arts.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

Section 1. That there be granted to the several States, for the purposes hereinafter mentioned, an amount of public land, to be apportioned to each State, a quantity equal to thirty thousand acres for each senator and representative in Congress, to which the States are respectively entitled by the apportionment under the census of eighteen hundred and sixty; *provided*, that no mineral lands shall be selected or purchased under the provisions of this act.

Sect. 2. *And be it further enacted*, that the land aforesaid after being surveyed shall be apportioned to the several States in sections or subdivisions of sections not less than one quarter of a section; and whenever there are public lands in a State subject to sale at private entry at one dollar and twenty-five cents per acre, the quantity to which said State shall be entitled shall be selected from such lands within the limits of such State, and the Secretary of the Interior is hereby directed to issue to each of the States in which there is not the quantity of public lands subject to sale at private entry at one dollar and twenty-five cents per acre, to which said State may be entitled under the provisions of this act, land scrip to the amount in acres for the deficiency of its distributive share; said scrip to be sold by said States, and the proceeds thereof applied to the uses and purposes prescribed in this act, and for no other use or purpose whatsoever; *provided*, that in no case shall any State to which land scrip may thus be issued be allowed to locate the same within the limits of any other State, or of any territory of the United States, but their assignees may thus locate said land scrip upon any of the unappropriated lands of the United States subject to sale at private entry at one dollar and twenty-five cents or less per acre; *and provided further*, that not more than one million acres shall be located by such assignees in any one of the States; *and provided further*, that no such location shall be made before one year from the passage of this act.

Sect. 3. *And be it further enacted*, that all the expenses of management, superintendence, and taxes, from date of selection of said lands previous to their sales, and all expenses incurred in the management and disbursement of the moneys which may be received therefrom, shall be paid by the States to which they may belong, out of the treasury of said States, so that the entire proceeds of the sale of said lands shall be applied without any diminution whatever to the purposes hereinafter mentioned.

Sect. 4. *And be it further enacted*, that all moneys derived from the sale of the lands aforesaid by the States to which the lands are apportioned, and from the sales of land scrip hereinbefore provided for, shall be invested in stocks of the United States, or of the States, or some other safe stocks, yielding not less than five per centum upon the par value of said stocks; and that the moneys so invested shall constitute a perpetual fund, the capital of which shall remain forever undiminished (except so far as may be provided in section fifth of this act) and the interest of which shall be inviolably appropriated, by each State which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one

college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.

SECT. 5. *And be it further enacted*, that the grant of land and land scrip hereby authorized shall be made on the following conditions, to which, as well as to the provisions hereinbefore contained, the previous assent of the several States shall be signified by legislative acts:

First. If any portion of the fund invested, as provided by the foregoing section, or any portion of the interest thereon, shall, by any action or contingency, be diminished or lost, it shall be replaced by the State to which it belongs, so that the capital of the fund shall remain forever undiminished; and the annual interest shall be regularly applied without diminution to the purposes mentioned in the fourth section of this act, except that a sum not exceeding ten per centum upon the amount received by any State under the provisions of this act may be expended for the purchase of lands for sites or experimental farms, whenever authorized by the respective legislatures of said State.

Second. No portion of said fund, nor the interest thereon, shall be applied, directly or indirectly, under any pretence whatever, to the purchase, erection, preservation, or repair of any building or buildings.

Third. Any State which may take and claim the benefit of the provisions of this act shall provide, within five years, at least not less than one college, as described in the fourth section of this act, or the grant to such State shall cease; and said State shall be bound to pay to the United States the amount received for any land previously sold, and that the title to purchasers under the State shall be valid.

Fourth. An annual report shall be made regarding the progress of each college, recording any improvements and experiments made, with their cost and results, and such other matters, including state, industrial, and economical statistics, as may be supposed useful; one copy of which shall be transmitted by mail free, by each, to all the other colleges which may be endowed under the provisions of this act, and also one copy to the Secretary of the Interior.

Fifth. When lands shall be selected from those which have been raised to double the minimum price in consequence of railroad grants, they shall be computed to the States at the maximum price, and the number of acres proportionally diminished.

Sixth. No State while in a condition of rebellion or insurrection against the government of the United States shall be entitled to the benefit of this act.

Seventh. No State shall be entitled to the benefits of this acts unless it shall express its acceptance thereof by its Legislature within two years from the date of its approval by the President.

SECT. 6. *And be it further enacted*, that land scrip issued under the provisions of this act shall not be subject to location until after the first day of January, one thousand eight hundred and sixty-three.

SECT. 7. *And be it further enacted*, that the land officers shall receive the same fees for locating land scrip issued under the provisions of this act as is now allowed for the location of military bounty land warrants under existing laws; *provided*, their maximum compensation shall not be thereby increased.

SECT. 8. *And be it further enacted*, that the governors of the several States to which scrip shall be issued under this act shall be required to report annually to Congress all sales made of such scrip until the whole shall be disposd of, the amount received for the same, and what appropriation has been made of the proceeds.

[Approved July 2, 1862.]

THE ACT OF 1887.

AN ACT to establish Agricultural Experiment Stations in connection with the Colleges established in the Several States under the provisions of an Act approved July second, eighteen hundred and sixty-two, and of the Acts supplementary thereto.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

SECTION 1. That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiments respecting the principles and applications of agricultural science, there shall be established, under direction of the college, or colleges, or agricultural department of colleges in each State or Territory established, or which may hereafter be established, in accordance

with the provisions of an act approved July second, eighteen hundred and sixty-two, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "agricultural experiment station": *Provided*, that in any State or Territory in which two such colleges have been or may be so established the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the Legislature of such State or Territory shall otherwise direct.

SECT. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantage of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SECT. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said stations, annually, on or before the first day of February. to make to the governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States.

SECT. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit. Such bulletins or reports and the annual reports of said stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster-General may from time to time prescribe.

SECT. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the results as hereinbefore prescribed, the sum of fifteen thousand dollars per annum is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the treasury proceeding from the sales of public lands, to be paid in equal quarterly payments, on the first day of January, April, July, and October in each year, to the treasurer or other officer duly appointed by the governing boards of said colleges to receive the same, the first payment to be made on the first day of October, eighteen hundred and eighty-seven: *Provided, however*, that out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appropriation may be so expended.

SECT. 6. That whenever it shall appear to the Secretary of the Treasury from the annual statement of receipts and expenditures of any of said stations that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SECT. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respectively located.

SECT. 8. That in States having colleges entitled under this section to the benefits of this act and having also agricultural experiment stations established by law separate from said colleges, such States shall be authorized to apply such benefits to

experiments at stations so established by such State; and in case any State shall have established under the provisions of said act of July second aforesaid, an agricultural department or experimental station, in connection with any university, college, or institution not distinctively an agricultural college or school, and such State shall have established or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the legislature of such State may apply in whole or in part the appropriation by this act made, to such separate agricultural college or school, and no legislature shall by contract expressed or implied disable itself from so doing.

SECT. 9. That the grants of money authorized by this act are made subject to the legislative assent of the several States and Territories to the purposes of said grants: *Provided*, that payment of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act shall be made upon the assent of the governor thereof duly certified to the Secretary of the Treasury.

SECT. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the Treasury to any or all the States or institutions mentioned in this act, but Congress may at any time amend, suspend, or repeal any or all the provisions of this act.

[Approved March 2, 1887.]

THE ACT OF 1890.

AN ACT to apply a portion of the proceeds of the Public Lands to the more complete Endowment and Support of the Colleges for the benefit of Agriculture and the Mechanic Arts established under the provisions of an Act of Congress approved July second, eighteen hundred and sixty-two.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

SECTION 1. That there shall be, and hereby is, annually appropriated, out of any money in the Treasury not otherwise appropriated, arising from the sales of public lands, to be paid as hereinafter provided, to each State and Territory for the more complete endowment and maintenance of colleges for the benefit of agriculture and the mechanic arts now established, or which may be hereafter established, in accordance with an act of Congress approved July second, eighteen hundred and sixty-two, the sum of fifteen thousand dollars for the year ending June thirtieth, eighteen hundred and ninety, and an annual increase of the amount of such appropriation thereafter for ten years by an additional sum of one thousand dollars over the preceding year, and the annual amount to be paid thereafter to each State and Territory shall be twenty-five thousand dollars to be applied only to instruction in agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural, and economic science, with special reference to their applications in the industries of life, and to the facilities for such instruction: *Provided*, that no money shall be paid out under this act to any State or Territory for the support and maintenance of a college where a distinction of race or color is made in the admission of students, but the establishment and maintenance of such colleges separately for white and colored students shall be held to be a compliance with the provisions of this act if the funds received in such State or Territory be equitably divided as hereinafter set forth: *Provided*, that in any State in which there has been one college established in pursuance of the act of July second, eighteen hundred and sixty-two, and also in which an educational institution of like character has been established, or may be hereafter established, and is now aided by such State from its own revenue, for the education of colored students in agriculture and the mechanic arts, however named or styled, or whether or not it has received money heretofore under the act to which this act is an amendment, the legislature of such State may propose and report to the Secretary of the Interior a just and equitable division of the fund to be received under this act between one college for white students and one institution for colored students established as aforesaid, which shall be divided into two parts and paid accordingly, and thereupon such institution for colored students shall be entitled to the benefits of this act and subject to its provisions, as much as it would have been if it had been included under the act of eighteen hundred and sixty-two, and the fulfillment of the foregoing provisions shall be taken as a compliance with the provision in reference to separate colleges for white and colored students.

SECT. 2. That the sums hereby appropriated to the States and Territories for the further endowment and support of colleges shall be annually paid on or before the

thirty-first day of July of each year, by the Secretary of the Treasury, upon the warrant of the Secretary of the Interior, out of the Treasury of the United States, to the state or territorial treasurer, or to such officer as shall be designated by the laws of such State or Territory to receive the same, who shall, upon the order of the trustees of the college, or the institution for colored students, immediately pay over said sums to the respective colleges or other institutions entitled to receive the same, and such treasurers shall be required to report to the Secretary of Agriculture and to the Secretary of the Interior, on or before the first day of September of each year, a detailed statement of the amount so received and of its disbursement. The grants of moneys authorized by this act are made subject to the legislative assent of the several States and Territories to the purpose of said grants: *Provided*, that payments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of legislature meeting next after the passage of this act shall be made upon the assent of the governor thereof, duly certified to the Secretary of the Treasury.

SECT. 3. That if any portion of the moneys received by the designated officer of the State or Territory for the further and more complete endowment, support, and maintenance of colleges, or of institutions for colored students, as provided in this act, shall, by any action or contingency, be diminished or lost, or misapplied, it shall be replaced by the State or Territory to which it belongs, and until so replaced no subsequent appropriation shall be apportioned or paid to such State or Territory; and no portion of said moneys shall be applied directly or indirectly, under any pretense whatever, to the purchase, erection, preservation, or repair of any building or buildings. An annual report by the president of each of said colleges shall be made to the Secretary of Agriculture, as well as to the Secretary of the Interior, regarding the condition and progress of each college, including statistical information in relation to its receipts and expenditures, its library, the number of its students and professors, and also as to any improvements and experiments made under the direction of any experiment stations attached to said colleges, with their costs and results, and such other industrial and economical statistics as may be regarded as useful, one copy of which shall be transmitted by mail free to all other colleges further endowed under this act.

SECT. 4. That on or before the first day of July in each year, after the passage of this act, the Secretary of the Interior shall ascertain and certify to the Secretary of the Treasury as to each State and Territory whether it is entitled to receive its share of the annual appropriation for colleges, or of institutions for colored students, under this act, and the amount which thereupon each is entitled, respectively, to receive. If the Secretary of the Interior shall withhold a certificate from any State or Territory of its appropriation the facts and reasons therefor shall be reported to the president, and the amount involved shall be kept separate in the Treasury until the close of the next Congress, in order that the State or Territory may, if it should so desire, appeal to Congress from the determination of the Secretary of the Interior. If the next Congress shall not direct such sum to be paid it shall be covered into the Treasury. And the Secretary of the Interior is hereby charged with the proper administration of this law.

SECT. 5. That the Secretary of the Interior shall annually report to Congress the disbursements which have been made in all the States and Territories, and also whether the appropriation of any State or Territory has been withheld, and if so, the reasons therefor.

SECT. 6. Congress may at any time amend, suspend, or repeal any or all provisions of this act.

[Approved August 30, 1890.]

III.

Historical Statements concerning the Passage of the U. S. Land Grant Act of 1862.

The following Historical reminiscences, of the passage of the law making a Land Grant to Colleges of Agriculture and the Mechanic Arts; showing the active coöperation of the late Dr. Amos Brown. of New York, and of the late Dr. Evan Pugh, of Pennsylvania, in promoting this result; consist of material furnished by Professor John W. Chickering, of the National Deaf Mute College, D. C., and of extracts compiled by the author of this "Special Report," from a Report made in 1864, to the Board of Trustees of the State College of Pennsylvania, by the President of the College, Dr. Evan Pugh.

In any great movement which ultimately results in legislative action, either by a State Legislature or by Congress, there must be of necessity, many zealous promoters of the new ideas or enterprises, for which are invoked the sanction of law; hence it is difficult, if not impossible, to indicate any individual who is solely entitled to the credit of the conception and initiation of the movement.

In State Legislatures and in Congress, where the assent of a majority of the members is requisite, often, owing to incidental emergencies, the introducer of the Bill and the person by whose name it may come to be known, is not, necessarily, the one who has been most earnest in its advocacy.—To designate any one person to whom the new measure is to be credited, would therefore, be either impossible or unjust.—Its success has been due to many friends in, and outside of, the legislative bodies.—For these reasons it would be difficult to distribute equitably the meed of praise due to all the originators and promoters of the first United States Land Grant Law in aid of Colleges of Agriculture and the Mechanic Arts.

The project brought many interested Educators to Washington to urge the passage of the bill, and to look after its provisions. Most prominent among these were naturally the officers or friends of existing, or projected institutions, that anticipated advantages to their given institution from the passage of the bill.

Whether Senator Morrill, of Vermont, who, as a member of the House of Representatives, in 1857, introduced a similar bill, which, after passing both Houses of Congress in 1859, was vetoed by President Buchanan, and from whom, as its introducer when a member of the Senate in 1862, the present bill took the name by which it is commonly known, is to be credited with the original conception of such a law is not known to the present writer; but what is known of all men is, that, in full accord with his life long record as the ardent friend of American Industry, he was ever the able and persistent advocate of the bill from its first introduction through all the intermediate stages to its final passage;—so that, in this instance,

his name was justly identified with the law. He had, for his coadjutors, the ablest and most far-seeing among the members of both Houses of Congress.

While it is not possible to enumerate here a list of the names of the early friends of the measure, I am glad to be able, through the courtesy of Professor Chickering, of the National Deaf Mute College, Kendall Green, Washington, D. C., to record the name of a leading educator who proved himself to be one of the most earnest of the advocates of the bill before Congress, and whose services and zeal in urging its passage are attested by letters from the leading friends of the bill in both Houses of Congress. Professor Chickering's notes, also, contain incidentally a brief history of the vicissitudes of the bill before its final passage.

While Dr. Brown, thus represents the great State of New York, the sister State of Pennsylvania, was not without its representative; who, it will be seen, makes the definite statement that without the aid and advocacy of the friends of the Pennsylvania State College, the bill would have failed.—It is not asserted that either of these distinguished educators originated the idea;—indeed the scope of the bill was so modified or rather enlarged during its progress through Congress, that it may not be possible for any one person to claim it as original. To that development is due its great utility—since no longer, as in its early conception, narrowed to the barest needs of the tillers of the ground, it now includes within its beneficent influence the educational interests of all workers or thinkers who, encircled by the ever widening horizon of the industries and arts of man, labor for the progress of the race.

It is due to the memories of Amos Brown, and Evan Pugh, that their efficient services in this great work should be here commemorated. To all others equally entitled, similar credit would here be gladly given, and it may well be, that the records here preserved may incite the friends of others, who likewise aided in the promotion of this great work, to preserve the memory of their efforts. When men come to honor the deeds of those who promote, by peaceful means, the progress of civilization, as they now exalt those who triumph in war; a long step forward will have been taken.

The following account of the part borne by the late Rev. Amos Brown, LL. D., in promoting the passage of the Land Grant Bill in aid of Colleges of Agriculture and the Mechanic Arts, is furnished by Professor Chickering.—

RECORDS OF THE EFFORTS MADE BY REV. AMOS BROWN, IN PROMOTING PASSAGE OF BILLS IN AID OF AGRICULTURAL EDUCATION.

Among the many men whose earnest conditions made them warm friends of what is commonly known as the Agricultural College Land Bill, and whose unwearied and efficient exertions secured its final passage, the name of Rev. Amos Brown, LL. D., should ever have a prominent place.

Not a practical farmer, much more interested in metaphysics than in natural science either theoretical or practical, he was nevertheless largely instrumental in conferring this princely gift upon the sciences of agriculture and applied Physics

Not a member of either house of Congress, without political experience, with none of the arts of the demagogue, backed by no monied interest, he was enabled by his earnest and honest advocacy of a cause in which he believed, by his tact in presenting that cause, by his ability to influence intelligent and candid men through argument, to render services whose value was readily acknowledged by the prominent friends of the measure in Congress.

As his name never appears in any public mention of the debates upon the bill, it is no more than just to him and to history that the facts of his connection with the success of the measure should go upon record.

Mr. Brown, was born upon a farm in Kensington, N. H., in 1804. He graduated from Dartmouth College, in 1833, supporting himself during his Collegiate course, mainly by teaching.

He also studied theology at Andover Theological Seminary, and was settled for two or three years as Pastor over a Congregational Church in Machias, Maine.

But teaching was his special forte, and to that work the last years of his life were given. He taught for one year at Fryeburg, Maine, and then for 12 years, at Gorham, Maine, where he so put in practice his educational theories, and so demonstrated his ability as an instructor as to raise the institution to the front rank.

In the fall of 1853, he assumed charge of the academy at Ovid, N. Y. which soon became, under his management, one of the prominent schools of the State.

One of the departments to which he gave great prominence in this Institution, known as Seneca Collegiate Institute, was that of Agricultural Education, inaugurating courses of popular lectures in addition to the regular course of study.

His attention was increasingly turned in this direction, and learning that a charter for a State Agricultural College in a neighboring county had been granted some years before, he set about securing that, and having the location changed to Seneca County. Learning that an unclaimed fund of $40,000 was lying idle in the State treasury, he conceived the idea of securing that as a loan, upon condition that the inhabitants of Seneca County would raise an equal sum.

He went to Albany, where some of the most influential members of the Legislature, themselves friendly to the plan, told him that he could not get a dollar of appropriation for any such purpose.

Undeterred however he went about the work, and soon demonstrated his remarkable ability as a lobbyist, to such good purpose that the bill passed the Senate unanimously, and the House by a very large majority.

As the result, the New York State Agricultural College was established and went into operation at Ovid, and Dr. Brown, as one of its trustees, was active and efficient in its organization though he was not, as it seemed to many of the friends of the College, he deserved, made its President.

He was however Aug. 12, 1857, elected President of the Peoples' College at Havana, N. Y. in which "Agriculture, with the various branches of manufactures, and the mechanic arts," were to be "systematically prosecuted within the college and its grounds, and as a part of its regular course."

EFFORTS OF DR. BROWN BEFORE CONGRESS.

More and more impressed with the importance of this department of education, and with the conviction that State and national aid should be freely granted thereto, the public lands had naturally suggested themselves to his mind as a practicable, economical, and constitutional means of accomplishing this end, and he had bestowed much thought upon this subject, so that when the first notice of the bill introduced by Hon. Justin S. Morrill, then a representative from Vermont, appeared in the papers, he at once said "I must go to Washington, and see what I can do in support of that bill."

This was in December 14, 1857, and from that time till its final passage in the Senate, in Feb. 7, 1859, he was hard at work in Washington whenever there seemed any need of or opportunity for his services.

This bill was vetoed by President Buchanan.

A similar bill was introduced by Mr. Morrill, then in the Senate, in May 5th, 1862, which passed the Senate on June 10th, passed the House on June 15th, and was finally approved by President Lincoln July 2nd, 1862.

At this time, again Dr. Brown's services were constant, judicious and efficient.

What estimate was placed on those services by the principal friends of the measure in Congress, will appear from the subjoined letters most of which were written, when the claims of the Peoples' College and its President, to the control of the share of lands allotted to the State of New York, were presented to the Legislature. As the result of these and similar representations, the whole grant was assigned to the Peoples' College upon conditions which seemed equitable and not difficult of fulfilment.

These conditions however were not met, and the endowment passed eventually to Cornell University.

These letters were written when the whole matter was fresh in the minds of those who had been active in the support of the bill, and may be supposed to express their honest and intelligent convictions as to the value of Dr. Brown's services in their behalf.

LETTERS FROM LEADING LEGISLATORS STATING THE EFFECTIVE SERVICES OF DR. BROWN IN SECURING CONGRESSIONAL ACTION.

WASHINGTON, D. C., *Dec.* 1, 1862.

DEAR SIR: I suppose your State Legislature may soon legislate in relation to the Donation of Lands for the establishment of Colleges for the benefit of Agriculture and the Mechanic Arts, by the late act of Congress; and if so, it is proper that you and other friends of the measure should know that the President of the N. Y. Peoples' College, the Rev. Amos Brown, took such an active part in securing the passage of the bill referred to, whenever it was before Congress, both by his earnest and intelligent advocacy of the measure through personal interviews and by efficiently urging the attendance of members on all occasions of any test votes, services continuing for months, that it is due to him and the institution of which he is the head, whenever a final disposition of the fund shall be made that his merits shall not go unacknowledged by the State of New York. From an early moment after the first bill was introduced he has been unflagging in his efforts to promote the success of this great measure in behalf of Agriculture and it is a pleasure to me to acknowledge the value of his advice and co-operation.

* * * * * * *

With great regard, sincerely yours,

JUSTIN S. MORRILL.

HON. E. B. MORGAN,
Aurora, N. Y.

WASHINGTON, *Dec.* 1, 1862.

HON. E. B. MORGAN,

SIR: I am requested to state to you what agency the Peoples' College of your State, had in procuring the passage of the law appropriating land for the Agricultural College in the several States and Territories.

Having taken a deep interest in that measure I ought to be qualified to speak with confidence on the subject and I do not hesitate to say that had it not been for the exertions of that institution, I do not believe the measure could have received the sanction of Congress. Great credit is due to the exertions of the Hon. Mr. Morrill of the House, for his unwearied labors in its behalf. Yet I always believed and still believe, that had it not been for the able, energetic and unwearied exertions of the Rev. Amos Brown, President of the Peoples' College, it would never have become a law.

It encountered great opposition in some quarters, on account of its supposed antagonism to the "Homestead Bill," and much also from the mere indifference of members who did not take interest enough in the measure to give it a thorough investigation, more still, from several members from the land States, who feared its passage would conflict with the rapid settlement of their States.

All these difficulties however, were overcome by the intelligent and persevering labors of Mr. Brown, whom I consider really the father of the measure, and whose advice I believe entitled to more weight, in carrying the law into execution than that of almost any other man.

* * * * * * *

Yours respectfully,

B. F. WADE.

AURORA, 17. *Dec.* 1862.

REV. AMOS BROWN,
President Peoples' College.
DEAR SIR:

* * * * * * *

The first man who suggested to me the passage of the bill which you meet to consider—was yourself—and from my own knowledge, the first bill passed—which was vetoed by Mr. Buchanan—would not have had the remotest chance in either house of Congress,—without your interest, labor, and most efficient efforts.

I have some letters from distinguished friends of the bill in the present Congress—showing what yourself and the friends of the Peoples' College have again accomplished—which you will please lay before the gentlemen you may meet.

* * * * * * *

Very truly yours,

EDWIN B. MORGAN.

WASHINGTON, *Dec.* 6, 1862.

MY DEAR SIR: At the request of Dr. Amos Brown, I take pleasure in testifying to his merits as President of the Peoples' College, and personally, in relation to the bill granting lands to the States, for agricultural purposes.

Mr. Brown, as I believe, was not only father of the bill, but to his persistent, efficient, and untiring efforts, its success was mainly due. I have no hesitation in saying that but for him it would have failed, in my judgment altogether.

Yours very truly

W. P. FESSENDEN.

MR. MORGAN.

WASHINGTON, *Dec.* 6, 1866.

DEAR SIR:

*   *   *   *   *   *   *

Dr. Brown is a man of very great energy and efficiency. The Agricultural interests of the country are indebted to him more than to any one—indeed every one else, for the passage of the law donating public lands to Agricultural Colleges.

Yours respectfully,

IRA HARRIS,

WILLIAM H. PARNELL, Esq.

NATIONAL HOTEL, *Jan.* 11, 1863.

Rev. AMOS BROWN,
DEAR SIR:

*   *   *   *   *   *   *

It gives me great pleasure to bear testimony to the aid you rendered in procuring the passage of the Agricultural College Bill.

It *might* have passed without you—I cannot say that it would not—but sure I am no one was so active, or so efficient as you in removing obstacles to it, and in securing it friends. * * *

You will remember I was much interested in the measure and anxious for its passage, and I will not withhold the opinion that the very highest consideration is due to you from your State and from the country for this eminently useful and just measure.

Very truly yours,

DAN'L CLARK.

WASHINGTON, *Feb.* 24, 1863.

The undersigned, members of the 37th Congress, certify to the efficiency of Rev. Amos Brown of Havana, N. Y., in advocating the passage of the law appropriating lands to the states for the use of Colleges. We believe there was no man who did more to impart information and furnish arguments showing the propriety of the law, and he richly merits the thanks of all its friends.

W. E. LANSING,
ALFRED ELY,
A. L. DIVEN, 27th Dist. N. Y.
R. E. FENTON, 31st Dist. N. Y.
R. FRANCHOT, 19th Dist. N. Y.
W. A. WHEELER,
A. B. ORIN,
A. W. CLARK,
J. P. CHAMBERLAIN.

The cumulative evidence as to the value of Dr. Brown's efforts, as given above, is convincing.

EFFORTS BY DR. EVAN PUGH, OF PENNSYLVANIA, TO PROMOTE LEGISLATION BY CONGRESS.

In a "Report" made by Dr. Evan Pugh, President of the Pennsylvania State College, to the Trustees of the College, in session at Harrisburg, January 6th, 1864—full reference to which will be found in the historical account of this College, given in the present volume of this Report (see *ante* pages 502–3)—occur the following statements relating to the passage of the law of Congress. Dr. Pugh's views

in regard to the purpose and origin of the movement for this Land Grant law, are of interest. The "Report" is evidently designed to induce the Legislature to give the use of the National Land Grant to this college, and strenuously urges the inability of the Literary Colleges to carry out the purposes of the Law. Dr. Pugh's statements of the scope and needs of the Institutions designed by the Law indicate a man of far reaching and comprehensive ideas.—The "Report" fills 36 pages. The following are the passages relating to the influence of the friends of the State College in promoting the action of Congress:

* * * Our next question is,

Can an Endowment Fund sufficient to yield $27,700 *annually be secured?*

It was with some such question as this before the minds of the Board of Trustees of the Agricultural College of Pennsylvania, that they labored for several years for the passage, by Congress, of the bill donating land to Agricultural Colleges.

It was with this question in his mind that one of the Board turned from the State Legislature, where he had labored successfully to secure funds to complete our College buildings, to his seat in Congress, where he labored no less successfully to secure the means of their endowment. * * *

The grant of Land and Land Scrip from Congress to the several States for the endowment of Agricultural Colleges.

The foregoing considerations, in great part, have had a general character, relating to the whole subject of Industrial Education, rather than to the Agricultural College of Pennsylvania in particular. This form of considering the subject has been adopted, because all questions involved in the general consideration applied with especial force to this College.

In closing this report I would venture a few remarks upon what would seem to be the legitimate object of the Land Grant by Congress, for the endowment of Colleges of Agriculture and the Mechanic arts.

This Land Grant was the result of the growing intelligence of the agricultural classes of the country, and the modern development of all those sciences which have a practical bearing upon the industrial operations of life. A necessity for Industrial Colleges was felt throughout the entire country. Literary Colleges not only failed to supply an education especially adapted to the peculiar necessities of the industrial classes, but through their highest officials they persistently proclaimed that no such special College education was requisite, and that the best education a young man could have to fit him for practical duties in life, was to be found in the study of Latin and Greek. The idea of Industrial Education was turned into ridicule, and Industrial Colleges were denominated visionary ideals of impracticable men. Determined that means should be provided for a general system of Industrial Education, a few prominent friends of such a system of education from other States, in conjunction with the friends of the Agricultural College of Pennsylvania, after about six years of persistent effort secured the passage, by Congress, of the Land Grant bill. This bill afforded sufficient land, or land scrip to each of the larger States, to enable them, with a reasonable effort from the State, to found one Agricultural College. Smaller States could only use it by establishing Agricultural Chairs in Literary Colleges, as they had not enough to endow an Industrial College. The object of the bill however, was *most distinctly not simply* to *found Industrial Chairs* in Literary Colleges, but to *endow Industrial Colleges* such as that, the organization of which has been discussed in this paper. * * *

5th. The friends of the Agricultural College of Pennsylvania secured the passage of the Land Grant bill by Congress.

A member of their Board of Trustees (then, as now, a prominent member of Congress) devoted almost an entire session in Congress to its passage, and other friends of the College visited Washington several times for the same purpose. *Without their aid the bill would not have passed.*

There is no discrepancy between the claims of Dr. Brown and Dr. Pugh and doubtless there were others whose efforts were as essential. It is "the long pull, the strong pull, and the pull altogether" that counts in Legislation.

IV.

Commemorative Addresses Delivered at Amherst, Massachusetts, on the 25th Anniversary of the Passage of the United States Land Grant Law of 1862.

INTRODUCTION.

While the foregoing account of the activity of two enthusiastic educators in urging before Congress the passage of the Land Grant Law of 1862, is of interest for the glimpse it affords of the far reaching views of the zealous friends of that measure; the following extracts taken from the Commemorative Addresses delivered in honor of the event, at the Commencement Exercises of the Massachusetts Agricultural College, at Amherst, in 1887, on the occasion of the 25th Anniversary of the passage of the Law; with their retrospective view of its beneficent activities, will be found of notable interest.

These addresses were issued in pamphlet form by the college.*

The opening address by President Adams, of Cornell University, New York, recalls the great additional value of this grant which was secured to the educational interests of that State, by the wise foresight, enterprise and generosity of the late Ezra Cornell, in his care for that imperial domain of territory given to it by the Nation. The words of Senator Morrill, charged with the practical good sense so characteristic of the man, and the account of the State institution of Massachusetts, whose honored guests they then were, so well told by the Hon. Charles G. Davis, are of veritable historical value. Want of space alone compels the giving of these "extracts," in place of reprinting the entire contents of this valuable memorial pamphlet.

Memorial Address

BY

Charles Kendall Adams, LL. D., President of Cornell University.

THE MORRILL LAND GRANT.

It was a remarkable evidence of the confidence and the composure of our federal legislature that in 1862, just twenty-five years ago, they were able to give their thoughts to the framing of that far-reaching act, in commemoration of which we are to-day assembled. It was at one of the most anxious, if not one of the darkest periods of our terrible war. The first great organized advance of the federal forces was just coming to a disastrous end. The Peninsula Campaign in which were centered all the nation's hopes had taken time for the most complete preparation in order that no repulse might be possible. Fair Oaks, Gaines Mill, Mechanicsville,

*Commemorative Addresses, 1862–1887, Massachusetts Agricultural College.—Addresses delivered at the Massachusetts Agricultural College June 21st, 1887, on the 25th Anniversary of the passage of the National Land Grant Act, Amherst, Mass.; J. E. Williams, Book and Job Printer, 1887, Pp. 61.

Cold Harbor, Malvern Hill,—names that even now send a shudder into thousands of American homes,—had followed in rapid succession, and our baffled army took up its retreat on the second of July, the very day on which, by the signature of the President, the act in which we have now so much interest, became a law. Little did the people think that at the very moment they were watching, with bated breath and tearful eyes for every new sign of success or repulse, there was going forward to completion in the halls of legislation at the National Capitol, a great act of statesmanship which in after years would bring the people together, as we are assembled here to-day.

A GREAT ACT OF STATESMANSHIP.

And yet a great act of statesmanship it was. In the few moments I shall detain you it will be my effort to show that its spirit was conceived in accordance with the best traditions of our country, that its provisions were in harmonious accord with the general spirit of the time, and that it was fraught with the means of incalculable advantage to the nation. To these three considerations, then, I briefly invite your attention.

Within the last twenty-five years the policy of rendering national and state aid to educational institutions has sometimes been gravely questioned. It has been asserted that the work of education, in any other than a purely elementary sense, should be left to the care of private benevolence. This, however, was not the doctrine of the fathers. As was so eloquently shown fifty years ago, when the orator selected to represent Harvard, and Amherst, and Williams pleaded the cause of the colleges before the Legislature of Massachusetts, it was the states acting in their organized capacity, that provided for the means of higher education as well as for the common schools.

THE TRADITIONAL POLICY OF THE NEW ENGLAND STATES.

Look at the facts of that early history. Years before the famous common school law was passed, provision had been made for the founding of a college, by means of a tax levied upon the whole people of the Colony. As Mr. Everett said, scarcely had the feet of the Pilgrims taken hold of Plymouth Rock, when a year's rate of the Colony was levied in order that the higher learning might have a home in the New World. Nor was the child of this parentage left to any such precarious support as might be afforded by private benevolence. The Court Records of Massachusetts in the colonial period are sprinkled over with evidence of the most solicitous care. It was in the days of poverty. The subsistence of the president and the professors or tutors, as they were then called, was immediately dependent on the bounty of the commonwealth. Appropriations for buildings and for lands were from time to time made. The income of the ferry between Boston and Cambridge was appropriated by the General Court to the use of the college. The legislature selected the controlling board. In short, Harvard College was an institution of the government, founded by it, supported by it and controlled by it. Before the days of independence arrived, more than a hundred different statutes had been spread upon the legislative record for the purpose of guiding and assisting this child of the infant state. Even in the constitution of 1780 it was declared forever to be the duty of the legislature to encourage higher learning and especially the University at Cambridge. And it was not until the sons of the college had multiplied and grown rich, that the legislature said to them as late as 1865: You can now care for your benignant mother better than I can, therefore I pension her off and entrust her fortunes to your generous keeping.

STATE AID TO EDUCATION.

The policy of Massachusetts was the policy of Connecticut. Long before Elihu Yale gave the final impulse for the founding of the college which was to bear his name, the General Court had carefully considered the establishment of such an institution. The subject was postponed from time to time, not because there was any question as to the propriety of founding such an institution; but because the population was as yet too sparse and too poor to furnish the pupils for two colleges in New England. And so it was not till more than sixty years had passed after the founding of Harvard that the second New England College was established. But after its establishment its history was much like that of its elder sister. During the whole of the last century, as the first President Dwight has said in his History, it was to the bounty of the Legislature of Connecticut that the support of Yale College was chiefly due. Again and again all other resources failed. It was the legislature that erected old Connecticut Hall and gave to it the name of its benefactor.

THE ORIGIN OF DARTMOUTH COLLEGE, IN NEW HAMPSHIRE.

Then look at the history of Dartmouth. The college began as a work of charity. Gradually it grew into something more than a secondary school. But during the years of its early growth, it never hesitated to call for aid upon the Legislature of New Hampshire; and its call was seldom heard in vain. It educated many of the sons of Vermont, and in due time it called upon the Green Mountain State for its share of assistance. A cheerful recognition of the obligation was the result. The land of a township was given to the college, and a record of the fact was stamped into the history and upon the map of the state by giving to the town the name of the college president.

A LIKE POLICY OF STATE AID TO EDUCATION IN THE SOUTHERN STATES.

What was true of the method that prevailed in New England was also true of the South. William and Mary, the second college established in the Colonies, took its name from the royal benefactors who made the first large contribution for its support out of the public treasury. The Colony was also taxed in behalf of the institution. A part of the value of every pound of tobacco raised in Virginia had to go into the treasury for the benefit of the college. This continued throughout colonial days. And when Jefferson conceived the plan of the University of Virginia, in some respects the grandest educational project ever devised in America, though he was inclined to intrust less authority to the government than any other of our forefathers, he endeavored to make the institution as much a part of the educational system of the state as were the common schools themselves.

HOW THIS POLICY PROMOTED HIGHER EDUCATION.

This method of supporting the colleges, moreover, was not only universal, it was also effectual in that it planted and nourished into maturity colleges of a high order of merit even in the infant days of our national life. Not only were admirable scholars made, but they were made in large numbers. The standards of those days, it is true, were somewhat different from the standards of our days; but one who looks at what was done, while recognizing great differences, will hesitate long before he pronounces them inferior. A recent and eminent superintendent of education in your own state not long since pronounced the opinion that the standards of higher education in colonial days were not simply relatively, but actually higher than the standards of the second half of the nineteenth century. I am not here to corroborate this statement or even to express an opinion on that point. But we may regard it as certain that the schools that could train the men of revolutionary days were efficient and were among the most valuable institutions of colonial time.

And when we pass on from colonial days to the days of the republic, we find that the propriety and the justice of these methods were universally recognized. That first great ordinance which still sheds its benign influence over the Northwest, provided that "Schools and the means of education shall forever be encouraged." And from the day of that benignant provision to the present time, no territory has been organized and no state has been admitted to the Union without provision that a part of its domain shall be set apart for higher learning as well as a part for the common schools.

THE MORRILL LAND GRANT LAW OF 1862 IN THIS LINE OF HIGH PRECEDENTS.

Thus it is that I hold the Land Grant of 1862 to have been in strict accordance with the best traditions of our educational history.

The second part of my thesis is that the Morrill Land Grant was in strict accordance with the spirit of the present time.

We, doubtless, sometimes talk flippantly and unwisely of what we call the spirit of the age. And yet the age in which we live has certain peculiarities which we can hardly go astray in trying to characterize. They are so distinctly marked, indeed they are so generally acknowledged and understood that even to speak of them, subjects one to the charge of dealing with the common-place. But the relation of these characteristics to matters of education is so important that I shall venture briefly to speak of them.

During the middle ages the work of the schools was limited to the education of those who were to go into the learned professions. It is even a matter of some doubt whether the great Charles, the organizer of schools in France and Germany, could himself write or read. It is certain that one of the greatest of French military leaders, as late as the time when the Renaissance was beginning to dawn, was absolutely illiterate.

Nor was this condition of affairs a singular one, or one that should excite our surprise. Before the introduction of the Baconian philosophy, the methods of looking at the problems of life were the reverse of the methods that have now come to prevail. Aristotle said, "Look into your own minds, study the nature of thought, look into the nature of things, and thus you will be able to reason out the course of conduct you ought to pursue." The Aristotelian philosophy prevailed until the seventeenth century. At length came Bacon and Descartes. Their methods were the opposite. They said, study things not so much in their nature,—which you cannot know anything about by a process of reasoning—as in their characteristics and relations. You are to reason from their external appearance and characteristics which everybody can investigate and in some sense at least understand into their internal natures. Thus it was that the Baconian or *inductive* philosophy had for its aim the setting of all thinking beings to the examining of the things everywhere about them. It taught not only that the domain of thought, but also that the domain of action, was open to the scrutiny of human intelligence. It exhorted everybody to pry into whatever there was within the range of observation. Examine the methods of nature, in order to discover the laws of nature. Examine the habits of animals in order to become acquainted with the laws of their development. Study the rocks, the trees, the plants, the flowers, in fact, study all the domain of nature, in order to discover the secrets of nature. The exhortation was followed in the course of the last century by the birth of what are called the Natural Sciences.

It is not singular that this method immediately began to insist on the examination of institutions as well as the things of nature. Heretofore, the rights of the church, the rights of the king, the rights of all governing powers, rested, not on any evidence that such forms and methods by actual experience had been shown to conduce to the largest happiness of man, but rather on some pronounced right that was founded on authority either human or divine. But now came a change. The Baconian philosophy taught that men might examine the conduct of government; and they drew the logical inference that if they might examine, they might act on the results of examination. This they did not hesitate to do. It is an interesting fact that the immortal work of Bacon which embodied and put into permanent scientific form the results of his studies and the substance of his philosophy was published in 1620, the very year of the Pilgrims at Plymouth, just twenty-two years before the vigorous outbreak of the English Revolution.

SIGNIFICANCE OF THE BACONIAN PHILOSOPHY.

Now what was the educational significance of this movement? Why, simply this. It opened the whole realm of nature as the legitimate field of investigation and study. Before this time the work of the schools and universities had been confined to developing the minds of the pupil and the teaching of the four learned professions—theology, medicine, law, and pedagogy. Universities had been established in the twelfth, thirteenth, fourteenth, and fifteenth centuries in all parts of Europe, but in no one of them were studies carried on in accordance with the modern investigating spirit. This is not strange, for the sciences had not yet been born. They could not come into existence till the investigating or inductive methods of study had come to prevail, and these methods it was that the Baconian philosophy ushered in.

A change of this nature was necessarily slow in making itself observed. But there was here and there a man who caught the new spirit and preached the new doctrine. The most enlightened man of the next generation was Milton. He had in the vast stores of his mind all the wealth of ancient learning. But he saw the full significance of the new philosophy and so every page of his tractate on Education is redolent with the modern spirit. Here are some of his words, "I call therefore a complete and generous education, that which fits a man to perform justly, skillfully, and magnanimously all the offices, both private and public of peace and war." This comprehensive definition might not inaptly be emblazoned as a motto upon the walls of every one of the institutions founded by the Morrill Grant of 1862.

But the doctrine of Milton was slow in permeating educated society. Institutions of learning are proverbially conservative. The universities resisted all change until the necessity of change made itself everywhere apparent. A century passed on during which the ideas of Bacon and Milton were gradually infiltrating themselves into the minds of the people. Then came the great book of Adam Smith on the Wealth of Nations,—a book which is entitled to this distinction that by combining the Aristotelian with the Baconian methods it sought to establish a science of wealth on a philosophical basis. The premises and the reasoning on which conclusions were founded were not in my judgment without great errors; but the book had its bearings on education scarcely less important than its bearings on political economy and finance. Its teachings were essentially this: the best

thing government can do with men, *as a rule*, is simply to protect them against abuses from their fellows, and then let them alone. This doctrine, however faulty,—and civilization is now teaching that it is full of faults,—carried with it this logical conclusion. If it be true, that men will most successfully work out their own fortune and destiny, when not interfered with by government, it follows that they must acquire the general intelligence suitable for self guidance, and, consequently, that far more generous provisions for education must be made than had ever before been provided for.

These doctrines of Adam Smith, moreover, were in complete harmony with what are commonly called the revolutionary doctrines of the latter part of the last century. Jefferson, as well as Adam Smith, preached the doctrine of letting men and things alone. And it was precisely because kings and parliaments and nobles and hereditary lords *would not* let men and things alone, that the revolution came on in America, and a little later in France.

THE BIRTH OF MODERN SCIENCE.

There is another phase of the course of events that is worthy of note. While the revolutionary ideas in regard to the proper attitude of government toward the people were taking root there was another revolution going on which had even greater significance. The Baconian doctrine of investigation was beginning to bear fruit. As a consequence the modern sciences had come into being. In all parts of the world every bright boy was looking into things. Every intelligent man was thinking of the ways by which his means of subsistence could be improved. You know the result was the most remarkable succession of inventions that history has ever known anything about. The power loom, the spinning jenny, the application of steam to the driving of machinery, the cotton gin, the invention of the locomotive engine, the building of roads and canals, not only changed the methods of existence from top to bottom, but also made everybody the near neighbor of everybody else. Contemplate one or two simple facts. At the middle of the last century it was still the regular method of conveying freight in England between London and the interior to put it into crooks thrown across the backs of mules, and send it along the narrow pathways that crossed the country. But what a miracle was soon wrought. When Emerson visited England about the middle of the present century he recorded in his "Notes" that the working power of steam in Great Britain alone, was equal to the strength of six hundred millions of men; and that thirty-six thousand ships were employed in carrying British products to distant parts of the world. What a mighty revolution was that?

It is interesting to note that these two revolutions, the political and philosophical on the one hand, and the social and economic on the other, were strictly contemporaneous. As we said that the date of the Novum Organum was the date of the Pilgrims, so we may note that the date of the "Wealth of Nations" and of the patents of Watt and Bolton were all within the years of our revolutionary war.

TECHNICAL AND SCIENTIFIC SCHOOLS THE OUTCOME OF THE NEW NEEDS.

Now it is a curious fact, that although it was in England that these two revolutions had their origin, it was also in England that the educational results of these revolutions were slowest and latest in making themselves felt. The reason, however, is not far to seek. England was the first to take advantage of the new inventions. Factories had sprung into existence on every hillside and on every stream, and British goods had taken possession of every market in the world. The statesmen in France and Germany saw that nothing but a systematic establishment of technical schools would regain for the nations of the continent the industrial importance which they had lost. And so industrial and technical schools were rapidly established. The Ecole Polytechnique came into existence in 1795. A school of similar purpose was established at Chalons in 1802; another at Angers in 1811, and another at Aix in 1843. The still more famous Ecole Centrale at Paris came into existence in 1829 with its array of schools for the education of mechanical engineers, civil engineers, chemists, and architects. Besides these there were established a vast number of trade schools of every kind, with shops for the teaching of methods of working in wood and iron and brass and other metals. In Paris alone there are more than a hundred such schools open alike to natives and to foreigners.

In Germany the activity in this direction has been even more marked. Austria has seven great technical schools and Prussia has nine. The new home of the Polytechnic at Berlin, perhaps the finest educational building in the world, has, it is said, accommodations for no less than four thousand students.

Moreover, besides these great centres of the higher grades of technical education, there is a vast number of schools of a more elementary grade. These are grouped about every industrial nucleus in the country. In Hamburg alone nearly a hundred

teachers are employed to give instruction in technical and industrial subjects to the thousands of pupils that throng the rooms. At the little mountain city of Chemnitz in Saxony there are five higher technical and trade schools, and so successful have these schools been within the past few years in producing skilled labor, that from the single county of Nottingham, in England, it is said that more than half a score of great manufacturing firms have transferred their machinery to Saxony in order to avail themselves of the superior workmanship that is there offered. And it is in this way that Germany, by means of her technical schools, is taking from England her industrial supremacy.

At last England has come to see her danger. At Manchester, at Sheffield, at Birmingham, and in London technical schools of some merit have recently been established. At last the scholastic tranquillity of Cambridge even has been disturbed by the noise of the saws and the lathes and the planing machines of a technical school; and even old Eton, that has rested for centuries in its quiet beauty under the shadows of Windsor Castle, and for centuries has been the favorite school of the scions of nobility, has been obliged to yield to the universal demand. By establishing a technical annex she, however unwillingly, has paid tribute to the inevitable.

THE FIRST AGRICULTURAL SCHOOLS.

But this is only one phase of the general movement. The other, that which pertains to agriculture, is equally striking and equally important.

Agricultural schools were established in Germany early in the present century. But it was not till after Liebig in 1844 published his famous work on "Chemistry as applied to Agriculture" that any real impulse was given to agricultural schools. But Liebig proved beyond the possibility of doubt two things. The one was that however great the draft upon the soil, the fertility may be fully maintained and even increased by restoring to the soil the mineral and the organic matter taken from it at the harvest. The second truth, and one even more important than the other, was that the proportions and quantities of the ingredients taken up by the crop are so variable and so different under differing circumstances that nothing less than a careful and scientific study of soils will enable one to restore those ingredients in the most efficient and economical proportions. It was accordingly held that for the encouragement of such studies, schools of agriculture must be multiplied.

HOW AGRICULTURAL EDUCATION IS CARED FOR IN GERMANY.

And from that day to this the number as well as the efficiency of the schools has steadily increased. Prussia alone has four higher agricultural colleges with some eighty professorships; she has more than forty lesser schools, all having model farms; she has five special schools for the cultivation of meadows and the scientific study of methods of irrigation; she has one special school for the teaching of those who desire to reclaim swamp lands; she has two special schools for teaching the growing of fruit trees in industrial nurseries; she has a school for teaching horse-shoeing; one for teaching silk raising; one for the raising of bees; and one for teaching the cultivating of fish. Besides all these she has twenty special schools for the education of gardeners; and fifteen schools for the training of those who are to cultivate the grape.

The example of Prussia has been imitated by the other German states. The little Kingdom of Bavaria, scarcely larger than Massachusetts, has twenty-six agricultural colleges, besides more than two hundred agricultural associations. Würtemberg, still smaller in area, has sixteen colleges, and seventy-six associations. Baden, with a population of only a million, has fourteen agricultural colleges besides four schools of gardening and forestry. Saxony, with its dense population of two millions compacted into a space hardly larger than two American counties, has four higher colleges and twenty agricultural schools besides a veterinary college, and a department of agriculture of twenty professors at the University of Leipsic. Saxe Weimar, with a population of no more than 230,000 souls, has three agricultural colleges besides an agricultural department with fifteen professorships at the University of Jena.

And what has been the result? Simply this, that while in every one of the American states, as is shown by the agricultural reports, the average crop per acre has been steadily growing less and less,* the average crop in Germany has been as

* Authority for this statement may be found in the Report of the Commissioner of Agriculture for the year 1886, p. 19. It is there shown that the average yield of the leading cereals between 1870 and 1879 was considerably greater than that from 1879 to 1885. The diminution is shown by the following figures: The average Corn crop declined from 26.8 to 25.1 bushels per acre; Wheat, from 12.5 to 12.1; Oats, from 27.5 to 27.2; Rye, from 14.2 to 12.8; Barley, from 22.4 to 22.08; and Buckwheat, from 17.5 to 18.6.

steadily growing more and more. In view of these facts, we ought to bow our heads in humility if not in shame. At least let us cease our unwarranted boasting about the superiority of our educational facilities.

Such have been the tendencies in other parts of the world, and I trust that you will agree with me in thinking that the Morrill Grant in purpose and in aim was in harmony with the general spirit and the best tendencies of the times.

WHAT THE "MORRILL" LAND GRANT LAW HAS DONE FOR THIS COUNTRY.

The third part of my thesis is the proposition that this land was fraught with the means of incalculable advantage to the nation.

I am willing to concede that in many cases the avails of the grant were not so large as they should have been. * * *

But notwithstanding the difficulties in the way of realizing the full value of the grant, no one, I imagine, will have the hardihood to deny that a great, an immense good has been accomplished. Look at a few of the facts and figures. The Land Grant amounted to 17,430,000 acres. The sum realized from the sale of this scrip is reported to have been $7,545,405. This sum has been greatly increased by additions of grounds, buildings, apparatus, and money given by benevolent individuals. In this way the land scrip fund, which in New York amounted to scarcely more than $600,000, has been augmented to not less than about $6,000,000. Though the university to which I refer has, perhaps, been the most fortunate of the land grant institutions, gifts with a similar purpose have likewise increased the endowments in other states. The result is that the latest reports show that these colleges now employ nearly five hundred professors and teachers, and give instruction to some five thousand students. Many of these students have, in turn, become teachers in other schools and colleges. From the institution with which I have the honor to be connected, I recall the names of at least twelve of the graduates who have become professors of some branch of Agriculture in other schools of collegiate grade. In a similar way, the other land grant colleges are disseminating knowledge on those great subjects which were especially named in the bill.

But this, of course, has been but a small part of the work. Thousands of young men, educated in the various branches of Agriculture and Mechanical Science, have gone forth to engage in the practical duties of life, and thus have disseminated and multiplied the knowledge they have received. The work is to go on with ever accelerating vigor, and thus there will be sent out a continued succession for all future time.

There is another feature of the benefits received from this great measure that ought not to be overlooked. I refer to the fact that centres of agricultural knowledge have been established in all the States of the Union. The science of agriculture, before almost absolutely unknown by the masses of the people, has come to be in some measure at last respected and even honored. The agricultural necessities of the country have been made more apparent. To some thousands of young men the stupendous fact is now taught that nature will not be cheated of her rights, and that for everything you take out of the soil, you must put something back, or the time will come when nature's cashier will cease to honor your drafts, and you will end in bankruptcy.

And what a field for such teaching there is; look at the statistics of our Agricultural Department. In every one of the states, in the North, in the South, in the East and even in the West, the yield per acre of all the great cereal crops has been steadily declining since the early years of the Century. The American farmer has impoverished the soil,—and then gone West. It is not certain that this process has even yet been arrested. The last statistics available for general comparison are not very reassuring. If the New England States have held their own, it has not been by means of improved agriculture, but by the general establishment of manufactories. The same process has been going on that converted many of the fertile lands of Virginia into pine barrens. As we all know too well thousands of acres in the Eastern States have been abandoned as practically worthless. Meanwhile the streams of immigration and emigration have been going on. The Irish and the Germans have come to Massachusetts; but the farmers of Massachusetts have gone to New York and Ohio, the people of New York have gone to Indiana and Illinois, and the people of Indiana and Illinois have gone to Kansas and the farther West. Ever westward has been the movement until the current has been arrested on the slopes of the Pacific. At length there is no West, to whose virgin soil we may flee. Our farmers no longer have the choice between remaining poor or moving toward the setting sun; they have the other alternative, the one which has long confronted the farmers of the old world, remaining poor or a more perfect knowledge of the conditions under which nature will yield a bounteous and profitable return.

DANGERS ARISING FROM RECKLESS DESTRUCTION OF FORESTS.

Then look at another fact. In many regions of our country the same desolating process is going on that has reduced the fertile fields about the Mediterranean to sterile deserts. The trees are being swept away and thus we attempt to frustrate the methods by which an all wise Providence designed that the moisture in the deep should be taken up into the plant and cast off into the clouds to be returned again as rain. What has been the result? The rainfall has been diminished, the showers which heaven still does not refuse to furnish, instead of being welcomed by the soft verdure of forests and cultivated fields and lovingly kept in the soil for the good of all animal and plant life, is repelled by parched hill sides, so that it shoots off in angry torrents and is soon once more in the lakes and the great rivers and the oceans beyond. Thus by a perfectly explicable method our climate is undergoing a change and it is the change which in some of the regions of the old world has caused the sands to drift over regions that were once the homes of a prosperous people.

And yet however great the difficulties may seem, there is no tendency of nature that is more amenable to the influence of man's appreciative intelligence. Everybody remembers Emerson's allusion to the ability of the English by the planting of trees on the borders of Egypt to bring rain again after a drought of three thousand years. We have been doing the same thing in the West; for the planting of trees and cornfields in Kansas and Nebraska up to the very frontier has already pushed the rain-line farther west by more than a hundred miles. The Reports of the Commissioner of Agriculture are teeming with facts of similar significance. It is estimated, for example, that the loss from the swine plague alone reaches annually some thirty millions of dollars, and that the value of corn and wheat annually destroyed by fungi is not less than the enormous sum of two hundred millions.*

These are some of the lessons and some of the necessities that are taught by experience; and yet they are only hints, as it were, designed to show how vast is the domain that invites the careful study of our schools and colleges. It is into this domain that the people were invited by the wise Land Grant of 1862. It is in this domain that the colleges and universities founded on that grant, if they live up to their high behest, will accomplish results that shall be for the helping, if not for the healing of the nations.

ADDRESS BY

HON. JUSTIN S. MORRILL, UNITED STATES SENATOR FOR VERMONT.

While having some words to which I may not unwillingly give utterance, yet, not until within the past two weeks have I had any expectation of being able, in response to the invitation of January last, to be present on this 25th Anniversary of the passage of the act by which this and other similar colleges have been established in the several states. I am glad to recognize your observance of the day as evidence that these institutions have won some consideration and hold here your cordial respect. I do not feel that the Land-Grant Colleges derive any dignity from the author of the act of Congress to which they owe their birth, however dear to me his reputation may very naturally be supposed to be. The existence of the Colleges can alone be vindicated by the reason that they are not superfluous but indisputably wanted; and that their work is not Utopian but practically of real service to the country. They must derive all of their dignity, not from any real or supposed obstacle encountered in their origin, but from the substantial equivalent they give for the four years of vigorous life surrendered by students to their guidance, and from the lustre reflected upon them by their *alumni*.

The importance of the early training of the horse and the ox has never been lost sight of by mankind; a seven years' apprenticeship has been thought not too much to acquire the skill of a master mechanic; and the importance of long terms of human training, for the professions of theology, law, medicine, and pedagogy, has for years been held to be indispensable. But these learned professions, important as they are, numerically include only a small fraction, comparatively, of the human race; and, yet, it is hardly too much to say, that our ancient colleges and universities mainly provided instruction originally intended exclusively for those who sought to be equipped for these special classes. The great majority of mankind, therefore, lacking perhaps neither ambition nor native ability, were dependent upon the hap-hazard of self-culture, or upon being taught in some brief way in the district-school how to read, write, and cipher. If this uncounted and unrepresented multitude sought to acquire knowledge of more practical value in the voyage of life, they soon found that useful knowledge was often estimated in ancient and richly endowed

* Report of Commissioner of Agriculture for 1866, Pp. 11, 24.

institutions to mark the humble station of steerage passengers, while the august institutions assumed to provide alone for passengers in the cabin, and, for them—having reluctantly abandoned the discipline of the "birch"—only intellectual discipline, the efficacy of which no one disputes, though no less efficacy may be claimed in behalf of studies for scientific use than for classic ostentation.

An eminent orator of Harvard College, it is reported, once asked, "What is a University?" and answered it by quoting himself as having said thirty years before that, "A University is a place where nothing useful is taught, and a University is possible only where a man may get his livelihood by digging Sanscrit roots."

This may have been sanctioned by the authority of longevity, and certainly appeared thirty years ago as too antiquated and limited for the general wants of American citizens, who claim that in any sphere of life education pays, that all persons, however humble their pursuits, become more valuable by education, more useful to themselves and to the community, and especially so where each one has a visible and responsible share in the government under which he lives.

Something more than a system of liberal education for the class of the so-called "liberal professions" was demanded, and this class, where the greatest number of representatives of the highest culture now exists, should all gladly welcome additions to their own numbers of other learned men. The great army of industrious laborers in the field and workshop, in mines and factories, or on railroads and other business enterprises—ready at any time to give their lives in support of the liberties and union of the nation—had some right to more of sound and appropriate learning that would elevate and especially profit them in their respective future careers.

THE FEW YEARS OF SCHOOL LIFE CONTRASTED WITH THE SUM OF DESIRABLE KNOWLEDGE.

The school-age of man is far too brief for the acquirement of all knowledge of philosophy, letters and science, and where the dead languages have the primacy, there is little chance for the sciences, for modern languages, or even for our native tongue, or, indeed, for much, with scholarly thoroughness, in anything else. A mere smattering of the sciences, or of the ancient languages, is no more to be coveted than even the old absolute unity of all college education. The organic law of the Land-Grant Colleges, therefore, made it a leading feature that instruction should be provided, without ostracising anything, in branches related to Agriculture and the Mechanic Arts, upon which, as we all know, the greater number of mankind must rely for their substance and happiness, as well as for their growth and reputation among men.

The sciences related to agriculture, tending, among other things, to increase the food products of the world, and the mechanic arts, upon which nations must lean for their independence and defence, should neither be ignored nor assigned to an inferior position. The mastery in these robust branches of learning requires training and brain-power, and does not exclude, though it may diminish attention to those branches of study too often regarded as the only branches where honors can be won, or as the only luxuries of a liberal education. * * *

TO WIN CONQUESTS FROM THE DESERTS OF IGNORANCE TO THE EVER WIDENING REALM OF INTELLIGENCE.

The Land-Grant Colleges were founded on the idea that a higher and broader education should be placed in every state within the reach of those whose destiny assigns them to, or who may have the courage to choose industrial vocations where the wealth of nations is produced; where advanced civilization unfolds its comforts, and where a much larger number of the people need wider educational advantages, and impatiently await their possession. The design was to open the door to a liberal education for this large class at a cheaper cost from being close at hand, and to tempt them by offering not only sound literary instruction, but something more applicable to the productive employments of life. It would be a mistake to suppose it was intended that every student should become either a farmer or mechanic when the design comprehended not only instruction for those who may hold the plow or follow a trade, but such instruction as any person might need—with "the world all before them where to choose"—and without the exclusion of those who might prefer to adhere to the classics. Milton in his famous discourse on education, gives a definition of what an education ought to be, which would seem to very completely cover all that was proposed by the Land-Grant Colleges; and Milton lacked nothing of ancient learning, nor did he suffer his culture to hide his stalwart republicanism. He says: "I call, therefore, a complete and generous education, that which fits a man to perform justly, skillfully and magnanimously all the offices, both private and public, of peace and war."

HOW THE NEW LAND-GRANT COLLEGES HAVE STIMULATED THE STUDY OF SCIENCE IN THE OLDER COLLEGES.

It was not desired that literary colleges should be superseded, or be in any sense dwarfed, as surely none of these elder colleges or universities could have any reason to complain at the prospect of an augmentation of the number of educated young men, nor could they have any reason to complain but should rejoice when reinforced by an additional corps of teachers—though differently equipped—enlisted in the earnest labor of training men for the noblest ranks of usefulness. There is room for all. Thorough culture is contagious. One educated young man creates an educational epidemic in a whole neighborhood. The only contention is that, in educational institutions of the highest dignity, scholarship in useful learning should stand as equal to scholarship in any other branch of education, and I hope to be pardoned for believing that it will do as much to discipline and to fashion as large a proportion in the hundred of men for distinction in society, and to make them valuable citizens, as well as authorities and ornaments in their respective vocations, entitling them as much to the honors of a college, as anything to be found in the humanities of a four years' university curriculum.

Within the memory of many of those who now live, the advancement of the useful arts and sciences is supposed to have eclipsed all previous records. Modern text-books of chemistry, botany, entomology, forestry, geology, metallurgy, electricity, mechanics, architecture, of zoölogy, would be unknown, if not "all Greek," to most college graduates of fifty years ago; but since the date of the Land-Grant Colleges, other colleges, endowed with sufficient means, have also responded with more or less liberality to the demand for instruction in these branches, leaving many of them elective or optional. The Land-Grant Colleges have, therefore, not only done good work of their own, but have prompted, perhaps, some good work upon the part of others. * * *

HOW STATES AND INDIVIDUALS HAVE SUPPLEMENTED THE LAND GRANTS TO THE COLLEGES.

The Land-Grant Colleges are now more than equal in number to the States of the Union, and light up some of the formerly destitute portions of our country. In eight states where the land fund appeared too limited for an independent institution, colleges have been successfully grafted upon the healthy stock of some existing literary institutions, and in no instance has such a junction bred intestine and internecine war. Most of the states have spontaneously aided the colleges by furnishing necessary buildings, and also by very liberal annual appropriations. Generous local bounties from towns and from private individuals also, have often been received. With hardly an exception these colleges are doing excellent educational work. It is a gratification to find that the largest endowment in any state has been husbanded most successfully, having fallen into very astute and worthy hands, and has served, with other large bounties, to build up the most complete and prosperous of all these institutions. I must also add that Cornell University, to which of course I refer, has been fortunate in her teachers as well as in her large-handed benefactors, and, whenever any special want has been developed, some generous friend has been ready to pour thousands after thousands into her lap.

VALUE OF THE MILITARY TRAINING GIVEN IN THESE COLLEGES.

The prescribed military instruction of these colleges, for each of which a professor is now detailed from the United States army, furnishes that measure of theoretical and practical knowledge necessary for organizing and drilling companies in any future emergency of our country, and its essential importance in a land where a merely nominal standing army is maintained, can hardly be over-estimated, especially if the officer detailed highly values his profession and has executive ability. As an incident, the drill offers a healthful and permanently beneficial discipline to students in promoting physical development and a manly bearing, incomparably superior to that of the gymnasium, or to that of any other athletic exercise or recreation.

In the first argument made by me in 1858 in behalf of the Land-Grant Colleges, I pointed out the fact that there was going on an annual deterioration of the soil, as it appeared by the decennial census reports, showing a less and less number of bushels of cereals produced per acre throughout nearly all of the states. This deterioration has not been arrested, though more vigilant attention is now given to the subject, and it is to be feared will not be wholly arrested until the scalping system of farming, or of cropping and returning nothing, shall no longer be profitable upon old homesteads that are to be abandoned with the hope of a future continuance

of the system upon the present limited prairies of the West. In various portions of Europe they are giving far more liberal aid to similar institutions than that which has been accorded in the United States; and they are there retaining the maximum fertility of their soil. There is no subject to our people of profounder concern, or of more far-reaching importance.

While it is true that the great profession of the law is most apt to qualify men for prominent public positions, it is true that the annual supply in the legal profession is supposed to exceed the demand, and that professional advancement is often provokingly slow; but we have it from the best authority that there is no overproduction in the Land-Grant Colleges, that few of their graduates remain long unemployed after leaving college. They are found in shops and on farms, and their services are sought after as teachers, as engineers, surveyors, foremen of shops and farms, superintendents of mines and manufactories, and frequently they are called to lucrative positions even before they have finished their studies. This enables them to enter more promptly into prosperous life; and many young ladies may be glad to know that it all tends to encourage early marriages.

WHAT THESE COLLEGES MEAN TO PATRIOTIC AMERICANS.

These colleges are thoroughly American, and for all time will be entrusted with work annually increasing in its importance. Our artisans are to contest with the skill and wealth of many nations, and our farmers are sorely pressed by the competition of agricultural products which cheap and rapid communication pushes to the front in all markets both at home and abroad. To successfully withstand this formidable rivalry, our countrymen need, and it is hoped will here find, that fundamental instruction which is founded on the widest and best experience of mankind.

Descendants as we are of the heroes who struck the blow for the National Independence of '76, proud of the production of a written Constitution which is esteemed by the enlightened statesmen of the world as the foremost form of free government hitherto devised by man, cheered by the mile-stones which mark the progress of our first century, we may well feel, as Webster felt, that "the past is secure;" but Americans, however, cannot afford forever to have no other ambition than to reach the goal once occupied by a people, however distinguished, of past ages. For "to whomsoever much is given, of him shall much be required," and the New World has been given to us forever as an inalienable possession, where we are not only to bridge great rivers and tunnel mountains, but to "make the wilderness and solitary places glad." All the centuries of the future are in reserve, under Providence, for the men of this great continent to make their own history, and, it is to be devoutly hoped, in some measure, to eclipse and take the lead of other nations, old or young, in worthy achievements in all the arts of peace, and in all the glories of manhood's ripest culture.

HISTORICAL ADDRESS BY HON. CHARLES G. DAVIS.

Our learned friend who has just addressed you, has discoursed upon the philosophy of agricultural education, and its progress in the old world. It is my humbler province to present facts concerning its advancement in our own country.

That history and human life present wonderful contrasts, great changes, and striking parallels are trite remarks; trite because so true, and so instructive, and because they present themselves to the observing mind, in tracing every subject of human interest.

In 1624 Gov. Edward Winslow brought to Plymouth in the Charity three heifers and a bull, "which," says the historian, "were the first neat cattle that came into New England."

* * * The poet, Longfellow whose fancy never recognized a close relationship to fact, in his "Courtship of Miles Standish" pictures Priscilla Mullens, the bride, as performing her wedding journey to the home of John Alden on a white bull. Longfellow here made a bull in every sense of the word. In the first place, at the time of John Alden's marriage there were no cattle in New England, and secondly, the first cattle imported were of a dark or red variety. The poet's poetic license was a "white lie" indeed. This bull of Longfellow's must be the same which crossed the sea with Europa on his back on her wedding journey with Jupiter. It is probably kept by poets for wedding journeys.

EARLY SCARCITY OF FOOD PLANTS CONTRASTED WITH PRESENT ABUNDANCE.

In 1623 the Colony of Plymouth was so straitened by lack of provision that it was reduced to a pint of corn, and lived for months without bread. Game and fish furnished their principal sustenance, and they gave thanks that they "could suck

of the abundance of the sea, and of the treasures hidden in the sand." The first comers had no plows. Their implements were scanty, poor, clumsy, and heavy. They at first used a shell for a hoe as the Indians did. Cast steel had not then been invented. Pumpkins, squashes, and tobacco were unknown to them, and potatoes were a luxury just introduced into England. This was the agriculture of New England two hundred and sixty years ago.

What need of worrying you with statistics of what it is to-day! The contrast is complete enough if I tell you that by the last census before the establishment of our College, the agricultural products of Massachusetts alone were thirty-two millions of dollars, and the value of her live stock over twelve millions. We have besides repaid the debt to England by the export of sheep, and cattle, and the fast trotting horse, and, besides the finest agricultural implements in the world, have added the sewing-machine to every farmer's fireside, improved every loom in the world, and presented its inhabitants with the telegraph and the telephone, and the fastest sailing vessels which have yet been known.

From the earliest settlement of this country to the presidency of Washington there is no record of any active efforts to improve our agriculture, except by a few feeble attempts at agricultural journals, and scattering agricultural associations generally of a social character.

On the 7th December, 1796, Washington in bis Annual Message, at the Second Session of the Fourth Congress, read these words:

"It will not be doubted that with reference either to individual or national welfare, agriculture is of primary importance. In proportion as nations advance in population, and other circumstances of maturity, this truth becomes more apparent, and renders the cultivation of the soil more and more an object of public patronage. Institutions for promoting it are supported by the public purse; and to what object can it be dedicated with greater propriety. Among the means which have been employed to this end, none have been attended with greater success than the establishment of Boards, composed of public characters, charged with collecting and diffusing information, and enabled by premiums, and small pecuniary aid, to encourage and assist a spirit of discovery and improvement. This species of establishment contributes doubly to the increase of improvements, by stimulating to enerprise and experiment, and by drawing to a common centre the results everywhere of individual skill and observation, and spreading them thence over the whole nation. Experience accordingly has shown that they are very cheap instruments of immense importance.

I have heretofore proposed to the consideration of Congress the expediency of establishing a National University, and also a Military Academy."

The proposition for a National University and a National Board of Agriculture, were referred to a Committee, and no report so far as I can learn was ever made upon the subject. The Military Acadamy became an Institution. Life was given to that which teaches men to kill their fellow men, but no encouragement to that science by which all men live. Here again is presented a striking contrast in our history. In 1817, to the honor of Massachusetts, be it stated, the Berkshire Agricultural Society, under the lead of Elkanah Watson, presented a memorial to Congress in favor of a National Board of Agriculture, by the Hon. John M. Hurlbut, their representative. Mr. Hurlbut was Chairman of a Select Committee on the subject, and reported in its favor; but although sustained by others with ability, the project was defeated by an overwhelming vote, owing to the constitutional scruples of some, views of expediency by others, and entire indifference and want of appreciation of the magnitude and importance of the world's most vital interest. Mr. Hurlbut stated that he was met with sneers and ridicule, particularly from Southern members for urging this subject. The same year Mr. Madison wrote, "I have never taken into particular consideration the expediency or the best plan of such an institution, being among those who do not view it as within the powers vested in the General Government." And now what a change! We have had an Agricultural Department of the National Government in the Patent Office since 1837, or thereabouts, and afterwards what is known as a Commissioner of Agriculture; and during the last winter the Democratic House of Representatives passed a bill establishing an Agricultural Department with a Secretary who was to be a member of the President's Cabinet. What has become of Mr. Madison's constitutional scruples?

THE FIRST GOVERNMENT REPORT ON EUROPEAN SCHOOLS OF AGRICULTURE.

In the Patent Office report for 1847, Mr. Charles L. Fleischmann made the first elaborate report on Agricultural Schools which he had visited abroad. During the last century the earliest Society for promoting Agriculture was established in Philadelphia, in 1785, and seven years after, the "Massachusetts Society for Promoting

Agriculture," was incorporated, March 7, 1792. The New York Agricultural Society was incorporated the following year. I learn that an Agricultural Society was also incorporated in South Carolina during the last century.

EARLY AGRICULTURAL ASSOCIATIONS.

In 1803 the "Western Society of Middlesex Husbandmen" formed in 1794 was incorporated, with a provision that members of the Massachusetts Society should be honorary members. A voluntary Agricultural Association was established at Sturbridge in 1799, one at Kennebec in 1791 and one in Brookfield in 1807; and some other voluntary Agricultural Associations had doubtless been formed in New York, and Massachusetts previous to 1807.* Meanwhile in 1801, a suggestion was made by an anonymous writer to the Massachusetts Society that a fair be held on Cambridge common in May and October, and bounties given for certain articles. This plan was not to have shows merely, but stated open markets for the sale of agricultural products. The same year 1801 brought forth a suggestion before the Massachusetts Society for the permanent endowment and support of a professorship of Natural History, and a Botanic Garden at Cambridge, which were in fact established in 1804, whilst before 1804 the Massachusetts Society had commenced the award of premiums for agricultural products, and had entered upon that generous and patriotic career of encouragement to our farmers which has done so much for the agriculture of New England, and the improvement of its stock.

It was in 1807 that a new era in the progress of agricultural education dawned in New England, which at first little noticed, was destined to mark an eventful change, and to hasten the progress an agricultural society had thought of a "cattle show" with premiums to be awarded in public, but the societies had confined themselves to printed publications, and to awards for essays and field crops, and for the importation of the best sheep. In the autumn of 1807 Mr. Elkanah Watson, a native of Plymouth and a direct descendant of Gov. Winslow who in 1624 had brought the three heifers and the bull to Plymouth, procured the first pair of merino sheep which had been introduced into Berkshire, and perhaps the whole Commonwealth. Col. Humphreys of Connecticut, then late minister to Spain had imported 75 ewes and 27 rams in 1802, and one Seth Adams had the same year claimed of the Massachusetts society a premium for two merino sheep imported from France. But the records of the society do not show that any premium was awarded Mr. Adams, nor indeed that they were ever in the State.

THE FIRST "CATTLE SHOW."

Mr. Watson gave notice of an exhibit of his two sheep on the public square in Pittsfield. He wrote that "many farmers and even females were attracted to this first novel and humble exhibition. From this lucky incident I reasoned thus: If two animals are capable of exciting so much attention, what would be the effect of a display on a large scale of different animals? The farmers present responded to my remarks with approbation. We thus became acquainted, and from that moment to the present have agricultural fairs and cattle shows, with all their connections, predominated in my mind." On the 1st of August, 1810, an appeal drawn by Mr. Watson and signed by 26 persons appointed an exhibition of stock on the 1st of October. This effort was successful, and resulted in a charter of the Berkshire Agricultural Society the ensuing winter of 1811. In the September following a formal and extended festival was held with "a procession of 69 oxen drawing a plow held by the oldest man in the county, a band of music, the society bearing appropriate ensigns, each member decorated with a badge of two heads of wheat in his hat, and the officers three heads secured by a green ribbon." Mr. Watson as president delivered the address and awarded the premiums which amounted to seventy dollars only.

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*Among the earlier contributors to agricultural education and interests I should not omit to mention the New York Horticultural Society, organized in 1818, which was the first society of its kind in the United States; the Pennsylvania Horticultural Society, organized in 1827, and incorporated March 24, 1831. The American Pomological Society, first known as the American Congress of Fruit Growers, was organized in 1848, and the Mass. Horticultural Society in 1829.

Nor do I overlook the great good which the various agricultural journals of the country have done in exciting the interest of the people in agricultural knowledge. I can only mention the "American Farmer," published in Baltimore in 1819, and ever since, which was the first regular agricultural journal published in this country, and the "New England Farmer," which originated in 1822. The later journals are too numerous to mention.

At the next exhibition in 1812 the premiums were $208. It seems now strange, though illustrative of the conservative tendency of human nature, and distrust of new things, that "valuable premiums were offered for articles of domestic industry; the day arrived; a large room was prepared; many superior articles of domestic manufacture, especially woollen and linen, were exhibited; but no female appeared to claim the premiums. Native timidity and the fear of ridicule restrained them. No one dared to be the first to support the new project." How did the original mind so full of resources, of Mr. Watson surmount the difficulty? "I left the hall," he says, "and with no small difficulty prevailed on my good wife to accompany me to the house of exhibition. I then despatched messengers to the ladies of the village announcing that she waited for them at the cloth show. They hastened out. The farmers' wives and daughters, who were secretly watching the movement of the waters, also sallied forth, and the hall was speedily filled with female spectators and candidates for premiums."

I have thus dwelt more at length upon the circumstances of the birth of the Berkshire "cattle show" than might seem necessary, not because it presents a curious parallel with the first cattle show on Plymouth Rock, but because the results of both present such striking changes and contrasts. The little one has become ten thousand. The grain of mustard seed overshadows the land. I verily believe that the social influences, the associate power, the joint sympathies and desires and the educational wants, aye, and the public influence on public men, of the agricultural societies which have followed this little show of two forlorn, imported sheep under the elm at Pittsfield, were moving forces without which the People, the Great Creators would never have blown the breath of life into the Board of Agriculture and the Agricultural College. If geese saved Rome why should not two sheep save agricultural education? But it is not the trifle, as such which saves, and that by accident as in the case of Rome, but the idea that the trifle may enforce, which generally saves or benefits the world.

"A small drop of ink
Falling like dew upon a thought produces
That which makes thousands, perhaps millions,
Think."

EARLY EFFORTS TO FOUND A STATE COLLEGE OF AGRICULTURE IN MASSACHUSETTS.

In 1849 Hon. M. P. Wilder in an address before the Norfolk Agricultural Society broached the subject of an Agricultural College, and the next year a bill to establish an Agricultural College and an experimental farm passed the Senate of Massachusetts unanimously, but was defeated in the House. A board of commissioners was then created, consisting of Mr. Wilder, Edward Hitchcock, Samuel A. Eliot, Thomas E. Payson and Eli Warren, and in 1851 their report with an elaborate account of the Agricultural Schools in Europe, visited by Prof. Hitchcock was made to the Legislature. It commenced by the remark that "the first seed ever planted was the first effort of civilization," and stated that no institution expressly for instruction in Agriculture had then been established either in this Commonwealth or in any other state. No immediate action resulted from their recommendations. In 1852 the Massachusetts Board of Agriculture was established. Mr. Wilder was persistent, and in 1856 obtained a charter of "The Trustees of the Massachusetts School of Agriculture," and during 1856 he also acquired from Congress a charter of the United States Agricultural Society, which was opposed in the Senate by Jefferson Davis on the ground, which now seems absurd, that Congress had no power to create corporations.

In 1860 a committee of the Board of Agriculture, consisting of Richard S. Fay, Marshall P. Wilder, and Ex-Lieut. Governor Simon Brown made an elaborate report upon agricultural education, and the Board caused to be published for the use of schools, a Manual of Agriculture," of which George B. Emerson and Charles L. Flint, its accomplished secretary, were the authors. All this information, showing however a difference of opinion among leading agriculturists, was before the public; and the farming community had become more alive to the necessity of more scientific and exact knowledge of agriculture than ever before, when Hon. Justin S. Morrill's bill was introduced by him in 1857, in the National House of Representatives, supported by numerous petitions of the people. It was passed and vetoed by President Buchanan in 1860; and the pendency of that bill, and a question of its location in Springfield or elsewhere had delayed action upon the charter of the Trustees of the Massachusetts School of Agriculture. That charter had passed into other hands. Mr. Morrill's bill was dead. In the winter of 1861 a renewed effort was made by Mr. Wilder, supported by petitions from all parts of the Commonwealth for a State Agricultural College. Hearings were had before the committee of education, and great pressure was brought to bear upon both

sides. The committee hesitated, and finally "let I dare not wait upon I would" by delaying the question. This was accomplished by reporting a resolve, Chap. 98, of the Resolves of 1861, authorizing Gov. Andrew to appoint a commission of three persons to serve without pay, to report a plan for an Agricultural College. The title of the Resolve was misleading. "Resolve in favor of the establishment of an Agricultural School or College." It was generally understood that this course was taken to get rid of the question without a decision on its merits. We had light enough. All these reports were before the people. With this knowledge the only way to organize a college was to organize, as Mr. Greeley said of specie payments, that the best way was to resume. No detailed plan ot a college could be made beforehand, especially if there were no indications what scale of a college was desired. Plans enough were already before the public. Mr. Thomas Plunkett of Berkshire, Increase Newton of Worcester, two elderly gentleman, and your historian here were appointed on the commission. The minds of neither of my seniors had ever been directed to the subjects, and they met with a feeling that the action of the Legislature was a feint, and that nothing was expected of them. We were advised not to report at once. Mr. Morrill's bill would be again offered under Mr. Lincoln, and if it passed, the mind of the Legislature would be forced to entertain the subject, and make full inquiry. We met once, when from the fact that I was at that time an Overseer of Harvard College, I was delegated to confer with Mr. Felton its president, and inquire officially whether any arrangement could be made or suggested for an Agricultural College, aided by the Bussey fund. Mr. Felton took a few days to reply, and finally answered very courteously that Harvard College took no interest in the subject. We met a second time, when I reported concerning Harvard College, and upon some questions as to the South fund at Northampton. I have never again had the pleasure of seeing either of these gentlemen before their death.

EARLY EFFORTS BY MR. MORRILL TO SECURE ACTION BY CONGRESS.

Meanwhile as I have stated, on Dec. 14, 1857, Hon. Justin S. Morrill, then a National Representative from Vermont, introduced a bill, to grant land scrip to the several states and territories at the rate of 20,000 acres for each Senator and Representative in Congress, for the endowment of a college in each, to teach such branches of learning as are related to agriculture and the mechanic arts. His idea was to bring as cheaply as possible to the farmer and mechanic, such education as is necessary to their several pursuits in life, to recognize agriculture as at least a leading, if not the chief interest of a state.

As the Spaniards when they took possession of new countries always raised the standard of the cross, an emblem to die by, so did Mr. Morrill with enlarged foresight resolve to plant a standard of agricultural education on the hilltop of every state like a beacon light to direct men how to live. His bill was referred to the Committee on Public Lands, who delayed their report four months to April 15, 1858, and then reported against it. Mr. Morrill enforced his views with elaborate and eloquent arguments, from which if there were time I should be pleased to quote to-day.

After many delays the bill passed fourteen months after it was offered, but was vetoed by President Buchanan on the 29th of Feb. (according to the Congressional Record), 1859, for various reasons: 1st because it was unconstitutional; 2nd because the government could not afford the outlay; 3rd because it would injure the new states by preventing settlements; 4th because the law would be of doubtful benefit; 5th because it would weaken existing colleges; 6th because this vast gift from the government would tend to alienate the states from the national government. Mr. Morrill made a full and triumphant reply to this veto, but the veto was sustained. Mr. Morrill persevered.

FINAL SUCCESS ACHIEVED BY SENATOR MORRILL.

In December, 1861, he again offered his bill, providing for 30,000 acres for each Senator and Representative, which was also referred to the Committee on Public Lands, which held it until the 29th of May, 1862, when Mr. Potter of Wisconsin reported against it. and it was referred to the committee of the whole. Meanwhile before the committee of the House had reported adversely, on the 2nd of May, Hon. Benjamin Wade of Ohio offered a bill of the same purport, which was referred to the Senate committee on Public Lands, of which Senator Harlan of Iowa was chairman. Promptly on the 14th of May, before the House committee had reported, he reported the bill with slight amendments, and on the 10th of June it passed the Senate without strong opposition. The next day the bill was sent to the House, and against the opposition of the Committee on Public Lands passed on the 19th of June, 1862, 25 years ago last Sunday; and Abraham Lincoln attached his name on the second of July following.

Thus did Mr. Morrill by his industry and persistency, like Elkanah Watson and Marshall P. Wilder, succeed in his great project. During peace under Washington, agriculture could not obtain even recognition by the government, but the arts of war were encouraged, I do not say improperly encouraged. In 1862 under Lincoln, in the midst of a civil wâr in which more forces were engaged, more blood shed, at a greater waste of treasure than were ever before known, Mr. Morrill's mind still turned from the work of destruction to the work of production which sustains men and nations, without which there would be no society, no commerce, no manufactures, no trades, and populous life of man could not exist. Taking the lead in drawing laws for raising revenue by internal taxes and by tariffs, he found time in the midst of war, to encourage the arts of peace. He believed that "Ceres should be counted among the Gods of Olympus."

And now, my friends, should you ask me to epitomize the progress of agricultural education in this country, I should name Watson, Wilder, and Morrill.

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Nearly twenty pages, which follow here in the pamphlet, are given to an interesting account of the incorporation and early organization of this Amherst institution and of its location and subsequent development, with brief biographies of the Presidents who were called from time to time to direct its destinies. Want of space compels the omission of these details, important as they are in the history of the individual institution.

* * * It cannot be denied that in the minds of many friends there have been some disadvantages in the location at Amherst, because of its proximity to a classical college; because it has been somewhat difficult of access, (a trouble which will soon be remedied); and because it has not attracted the beneficent grants and bequests, which it might have received if in the neighborhood of a great city.

As to the first consideration, it is due to Amherst College to state that the suggestion is made solely as to the relations, real or supposed, between the two classes of students. Amherst College, on the contrary, has not only scrupulously adhered to pledges made by its president, Dr. Stearns, when the location of the Agricultural College was under consideration, that the elder college would urge or countenance no movement for annexation or absorption, but would do what it could to accommodate the Agricultural College, but it has offered accommodations at times, and granted the agricultural students access to its library, etc.

Nor do I think the college has suffered much from the last consideration. Although a large number of retired gentlemen, such as formed the Massachusetts Society, have shown great interest in the advancement of our agriculture, the active mercantile and manufacturing interests of Boston have never taken interest in the origin or success of the college, whilst the metropolitan press has almost universally and constantly depreciated and disparaged the institution. President John Adams, who was in 1805, president of the Massachusetts Society, nevertheless in 1812, wrote as follows: "We say and say truly that agriculture and commerce are sisters, and their interests mutual and consistent; but the misfortune is that individuals and masses of both orders of men do not always understand the existence of both interests, and instead of endeavoring to reconcile them, employ all their policy and influence to counteract each other. The merchants in all the seaports discouraged the growth of wheat in the state. Why? Because they supply us with flour from New York &c. and the article constitutes an important link in the chain of commerce. Agriculture patriotism is one thing, and mercantile patriotism another in our dearly beloved Massachusetts; both equally sincere, both equally *bona fide.* You will get no aid from Boston. Commerce, literature, science, theology, are against you;—nay, medicine, history, university, and universal politics might be added." I do not adopt this extravagant statement of Mr. Adams as strictly applicable at present, but quote it as a curious coincidence with the fact I was stating.

Neither am I discouraged by any indications of a want of interest in the college, or in the number of its students, but only in the want of funds to sustain a college as it should be. The Commonwealth cannot do for this college what it pledged itself to do, without money.* But students will come as fast as we can accommodate them, and do them justice. I have too much faith in the progress of the age, to suppose for a moment that any effort to develop an accurate science and knowl-

* It ought to be known that among the numerous inquiries by letter during the last year over ninety poor men sought admission to the college provided they could earn their way by work upon the farm and by other means. Manual labor of students is not, of course, profitable in itself. No one could do more good in the educational direction than by donating in whole or in part to a fund of $100,000, to be known as the "Manual Labor Fund."

edge of gathering succor from our mother earth will be a failure. Why, in 1805, I read that Mr. Morrill's own University of Vermont had thirty students, and one professor, and he was the president. I had just entered Harvard in 1836, when she celebrated her second centennial, and hear Oliver Wendell Holmes recite his verse:

"Who was on the catalogue
When college was begun?
Two nephews of the president,
And the professor's son.
They turned a little Indian b'y
As brown as any bun.
Lord! how the Seniors knocked about
The freshman class of *one*."*

Neither am I discouraged by any want of success of the college either in its instruction, or in its experimental work. Under the circumstances it has far exceeded any reasonable expectations. It is remarked by friends, who have most closely watched its graduates, that they were better prepared for the actual work of life than those of the classical colleges. I purposely avoid any discussion of the philosophy of an agricultural education, and of the scope and sphere of this college. My province is confined to a relation of facts of the past. But it is proper that I should remind you that Agassiz declared that the experiments on the circulation of sap in plants, and their expansive power during growth are worth all the college had cost the Commonwealth.

SUMMARY OF EXPERIMENTAL WORK DONE IN THE COLLEGE.

I append a summary, which it would be irksome now to read, of the experimental and other scientific work conducted at the college.

On the use and effect of common salt on grain and root crops. 1869. *Goessmann.*

The construction and repair of highways. 1869. *Miller.*

The establishment of true meridian lines as the basis of all surveys. 1870. *Miller.*

Report on the management of stock. 1871. *Dillon.*

Strassfurt-salines as a potash resource in agriculture. 1871–72. *Goessmann.*

The growing of sugar-beets, the manufacture of sugar from them, and trial of their value for cattle food. 1871–76. *Goessmann.*

Report on sugar-beets raised on the college farm. 1872. *Goessmann.*

Fertilization of farm lands with reference to commercial fertilizers. 1872–73. *Goessmann.*

The circulation of sap in plants and their expansive power during growth. 1873. *Clark.*

Practical trials of new implements and farm machinery. 1873. *Dillon.*

The sources of supply and the quantity and quality of our manurial agents. 1873. *Goessmann.*

Investigations of the quality and composition of commercial fertilizers offered for sale, and the protection of the community from fraud by legal control and inspection. 1873–86. *Goessmann.*

Observations on the phenomena of plant life. 1874. *Clark.*

Experiments with compound commercial fertilizers to test their comparative agricultural value and their value as compared with single elements. 1874. *Stockbridge.*

Experiments to determine what element will make practically a complete manure on our average soils. 1874. *Stockbridge.*

Laboratory and physical examinations of the South Carolina phosphates; trial of their agricultural value in the raw state and after treatment with acids. 1874. *Goessmann.*

Examinations of varieties of sugar-beets raised throughout the State of New York, Lower Canada, and the Connecticut River Valley. 1874. *Goessmann.*

The chemical and physical condition of the salt marshes of the state, and the devising of methods by which they can be made available for agricultural purposes. 1874–77. *Goessmann.*

To determine, in feeding substances, the proportions of different elements of nutrition required to save needless expense, and to produce the most certain results. 1874–75. *Stockbridge.*

Experiment on the continuous growth of crops on the same soil with chemical fertilizers alone. 1874–75. *Stockbridge.*

*Turn to the Harvard catalogue and you will find: In 1643 4 graduates, in 1640 and 1641 none, in 1644 7, in 1645 7, in 1646 4, in 1647 7, in 1648 5, in 1652 1, in 1654 1, in 1655 2, in 1656 4, in 1672 none, in 1673 4, in 1674 3, and so on, whilst the class of 1685, consisting of 14, was the largest class which had graduated during the fifty years since the "college was begun," and twenty-two was the largest number of any class prior to 1719.

On the dentition of domestic animals. 1875. *Cressy.*

Experiments with different varieties of potatoes. 1875. *Maynard.*

Investigation of dairy products—oleomargarine, Jersey, and skim-milk cheese. 1876. *Goessmann.*

Examinations of animal secretions; variety of urinary calculi, etc. 1876. *Goessmann.*

Investigations on the effect of girdling fruit-trees and plants to hasten the time of ripening and to improve the quality of the fruits. 1876. *Goessmann and Maynard.*

Experiments with fertilizers upon sugar-cane carried on in Louisiana. 1876–78. *Goessmann.*

Examinations of various vegetables and fruits. 1876–86. *Goessmann.*

Examinations and trials to test the comparative value of different methods of setting and treating milk in the butter-dairy. 1876–77. *Southwick.*

Notes on compensating-powder; being a brief consideration of a new mechanico-chemical explosive, for heavy artillery purposes. 1877. *Totten.*

The comparative study of milk of different breeds of cows under the same treatment. 1877. *Goessmann.*

Contribution to the chemistry of American wild and cultivated varieties of grape wine. 1878. *Goessmann.*

Investigations on temperature of soil and air, and on deposition of dew on the soil and plant. 1878. *Stockbridge.*

Investigations in relation to the evaporation and percolation of water from the soil. 1878. *Stockbridge.*

The tilling of soils of different characteristics as affecting the loss of water by evaporation. 1878. *Stockbridge.*

Investigations in relation to the comparative temperature of the soil and air by day and by night. 1878. *Stockbridge.*

Investigations concerning the saccharine qualities of several varieties of corn and melons. 1879. *Goessmann.*

The growing of early amber cane, and the manufacture of sugar from its juice. 1879. *Goessmann.*

Investigations of the comparative nutritive and feeding value of Northern, Southern and Western varieties of Indian corn. 1879. *Goessmann.*

The determination of the elements of plant nutrition lost from the soil by leaching, and of those it retains. 1879. *Stockbridge and Goessmann.*

Report on lysimetre. 1879. *Stockbridge.*

The effect of chemical salt on the carbo-hydrate contents of plants and the quality of the fruits. 1880. *Goessmann.*

Experiments regarding diseased peach trees (yellows, etc.). 1880–81. *Goessmann.*

Experiments regarding the influence of special manures on fruits, etc. 1881. *Goessmann.*

The system of preserving green food in silos. 1881. *Goessmann.*

Investigations in relation to unconscious bias in walking. 1884. *Miles.*

Investigations in reference to bilateral asymmetry of form and function. 1884. *Tuckerman.*

Experiments with new varieties of fruit. 1887. *Maynard.*

A GRACEFUL TRIBUTE TO THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Nor should this college at this hour, and especially in this presence, forget to present its congratulations, and send its God-speed to its twin sister, the Massachusetts Institute of Technology, both sired, in equine phrase, by "Uncle Sam" out of "Massachusetts."

In the land of old Laconia
  Where the Muses still abide,
Alpheus fair and young Eurotas
  Flowed adown the mountain side.

They were twin-born lovely children,
  Free as air, and fair as free.
From the selfsame fountain springing
  Life to them a jubilee.

Not alone on far off hill-side,
  Twin-born gifts of God do come;
Joyfully we hear their voices
  Near our Athens here at home.

It is also our joy to learn that the legislature has just presented her with a conditional dowry of $100.

IN HONOR OF THE ALUMNI OF THIS COLLEGE.

I shall never forget the pleasure with which a year ago I attended a dinner of the "Associate Alumni." I felt somewhat like Simeon of old, and could not well realize that here within twenty years was this full bloom and fruit of a college, a college with an association of graduates indeed. I can therefore imagine with what riper pleasure you, Mr. President, who have known, and taught, and guided and advised, from the day the first student was admitted here, and with what pride and satisfaction Mr. Morrill, came to this celebration. These are his jewels. These are the beginning only of those long processions, which from every state and territory, I trust to the end of time, will come and go, rejoicing in the lamp of knowledge which he will have presented them, and recognizing him as their father, even as the Jews said "we have Abraham to our father." We alone are leading the procession with more than 350, besides those who have dropped out by the way. Yes, they

"Are coming, Father Abraham,
Five hundred thousand strong!"

The future graduates of these 38, nay 50, 60 colleges, more numerous than the seed of Abraham, tracing their lineage from no myths, like those of Greek or Roman story, seeing clearly that they were conceived and born of no unholy passions, suckled by no wolfish or beastly natures, will thank God that it was from the far-seeing brain of a wise statesmanship, that these colleges, like Minerva, from the brain, and not the lust of power, sprang into life. This morning from every English fireside, with million voices, have rolled the notes of the national anthem, for a woman who during fifty years, as maid, and wife, and widow, with feminine dignity, and the respect of all men, has sat upon the British throne. But Victoria herself has accomplished little as a ruler, or law-giver. Have we not greater reason on this year of the twenty-fifth anniversary of the passage of the bill which gave us life, and which put Agriculture on the throne to which she is rightfully entitled, to exclaim "God save the Senior Senator of Vermont! To him be the honor to the world's end!"

THE FUTURE PORTRAIT GALLERY OF THE COLLEGE.

And before we shall have lain down from our labors here, I look forward to the time when the college hall will be decked with the painted images of those who have been the creators or benefactors of this institution. I would have *here* Morrill, the statesman and law-giver; *there*, the venerableness, gentlemanliness, energy, and proud beauty which shone in the countenance of Wilder; and over against him, the earnest face, the eager eye and nervous vigor of Clark, the young man, enthusiastic for the future; *there*, the scholarly, professional portrait of Chadbourne; *here*, the frankness, honesty, guilelessness, common-sense, and friendliness which so mark the face of Stockbridge; and I would not fail to find a picture of benevolence, generosity, modesty, and sadness lit by a heavenly smile, which were illustrated in the person of William Knowlton. My gallery would include still others among the living as well as the dead.

And when in after time the long list of the faithful and devoted servants of the college shall be scanned, one will be found who from 1867 was professor of modern languages and English Literature; from 1867 to 1869, instructor in gymnastics and military science; in 1869 lecturer in entomology; in 1869 and 1870 instructor in zoölogy; from 1869 to 1871 instructor in anatomy and physiology; in 1872 and 1873 instructor in history; in 1885 and 1886 librarian, and finally in 1886 president of the college, Goodell's name "will lead all the rest."

V.

How Agriculture is Taught in One Country in Europe.

INTRODUCTION.

I am indebted to the courtesy of the author for permission to use the following valuable and interesting paper which was prepared by Professor R. B. Warder, formerly of the Cincinnati University, Ohio, and at present one of the Faculty of Howard University, Washington, District of Columbia.

Professor Warder, passed a year in Bavaria in careful study of the system of Industrial Education as established in that country.

This paper, relates directly to the training there given in Agriculture; and is, for this reason, placed here among the Appendices relating to the American Colleges of Agriculture. It will be observed, however, that in Bavaria, this education is by no means limited to the colleges, but beginning in the earliest schools, the Kindergarten, goes hand in hand with the pupil through the elementary and superior schools up to the highest technical institutions.

This gives to Professor Warder's account a more general interest for American educators than if it were limited strictly to an account of the technical schools alone.

While, on the one hand, he points out the thoroughness of preparation required for entrance into the higher institutions, in striking contrast with the lack of such thorough preliminary training requisite for admission to *some* of the American Colleges of Agriculture; on the other, his suggestions as to what may be accomplished by simple means in country district schools, and by the holding of winter schools in farming neighborhoods; and, in other ways, by the voluntary coöperation of neighboring farmers, lend additional value to this paper, of which the Farmers Granges may readily take advantage.

His suggestions as to the feasibility of tree planting and of making garden plots in school yards, seem to have borne practical fruit in the growing prevalence, in several of the States, of the annual celebration of "Arbor Day" devoted to tree planting.

A short article on "Tree planting in School Grounds" by the late Dr. Franklin B. Hough, was issued as a Bulletin by the U. S. Bureau of Education, in 1883, and reissued as a pamphlet in 1885,* in connec-

* "Planting Trees in School Grounds and the Celebration of Arbor Day." Pp. 8 & 64.

tion with a paper preparea by Hon. John B. Peaslee, when Superintendent of Schools in Cincinnati, and first published by the Ohio State Forestry Association in 1884. These papers, with the choice extracts from various writers given by Dr. Peaslee, form a most interesting contribution to the literature relating to school life; and furnish, also, a valuable compendium of facts bearing upon the Science of Forestry.

Agricultural Education in Bavaria.*

[By Professor R. B. Warder.]

The standing of the Germans in the first rank of educated nations does not depend upon their Universities and Polytechnic Schools alone; it is due rather to the patient striving, on the part of both people and government, to provide every citizen with the most complete and appropriate education that his circumstances will permit. Free tickets of admission to the lecture-rooms of the most distinguished professors cannot imply real opportunities for education, unless the pupil has the needed preliminary knowledge and mental discipline in order to understand and digest the lectures. Any system of education designed for the whole people will embrace many different grades; we must not expect too much from the higher institutions alone; and the object of this paper is to exhibit the variety of schools in which the interests of practical agriculture are subserved in the Kingdom of Bavaria. We may also find some useful lessons for our own Republic.

ELEMENTARY TRAINING ESSENTIAL.

We must begin with the *Kindergarten*, for here is cultivated the child's instinctive love of nature; here he is taught to observe the forms and growth of plants; and we cannot estimate how much is due to the habits of observation and the love of plants thus imparted, even before the school age.

Compulsory education is the rule, including (as the minimum) seven years of daily attendance at the common schools ("Volksschulen," or "people's schools"), where (in all the country schools) orchard and garden culture is a part of the course. The design of this provision is to show the great value of fruit culture, and to instil the love for planting, protecting and caring for fruit trees; and thus through a just public sentiment to prevent the habit of orchard thieving. For this purpose it is expected, where possible, that local means shall provide a piece of ground for an orchard in connection with each school. It is very common to provide the teachers with a dwelling, or a dwelling and garden; in the latter case part of the teacher's garden may be used for purposes of instruction. In the Oberpfalz, the minimum size is four *ares* (metric measurement), or about one-tenth of an acre. A suitable location is to be selected; but if the climatic conditions are quite too unfavorable for fruit, other useful trees and shrubs are to be planted. Where there is room, vegetables and flowers may also be raised. After the first plowing and planting, the work must be performed by teachers and elder pupils, and half of the crop belongs to the teacher as compensation for his labor. Practical lessons are given in the orchard itself, out of the regular school hours, and in the Oberpfalz all the boys are required to take part in this instruction. The school directors and superintendents have to see that this department of teaching receives due care; and the teachers, during their five years of normal school training, have time to become qualified for such work.

SUPPLEMENTARY COMPULSORY SCHOOLS.

But even with seven years' compulsory attendance of more than ten months in the year, the results are not the highest that may be reached. If the boy begins to learn a trade or to work all day on the farm in his fourteenth year, he may still spend part of his Sundays and evenings in mental improvement; and for this class, several different kinds of schools are provided, according to the special wants, in which the pupils are taught from two hours per week to eight hours or more, according to local needs and possibilities. These are known as "Fortbildungs-

* Extracted from the Journal of the American Agricultural Association. Vol. 1. Nos. 2 and 3.

schulen," and attendance in them for two or three years after leaving the "people's school" is still compulsory. In those designed for farmers' sons, the main stress is still laid on elementary branches, but an Agricultural Reader is used, and the exercises in writing and arithmetic are directed in the line of agricultural applications. In 1873 there were 1,096 such schools in Bavaria with an average of 19 pupils each.*

For farmers' sons, even of the hard-working classes, still other opportunities are possible, which could not escape the notice of the prudent German. Various *Winter Schools* have accordingly been established by the several agricultural societies, to be kept open from November to February inclusive. In 1872–3 there were eleven of these schools, and others were projected. The organization varies according to local needs, and the means at command, but the course of study extends through one, two or three winters. Besides the common school branches (including religion), instruction is given in the elements of natural science, field culture, the raising of animals, book-keeping and farm management; also, where it is possible, in drawing, field-measurements, drainage, soils, tools, and fruit culture. At Würzburg, where there is a force of eleven teachers, agricultural law, geography and history have been included. It is remarkable to see the liberality of both the State and the agricultural societies in providing such schools, as contrasted with the apparent indifference of the great mass of laboring farmers. The fees for tuition are not high, and the necessary living expenses are made as low as possible, that none may be excluded from want of means. Some idea of the appropriations of money required may be realized from the report of 1868–9, that in the seven Winter Schools then established 53 teachers instructed 157 pupils! Each teacher, however, is generally employed but a few hours every week to give instruction in his own department. Besides the teachers' salaries, buildings, fuel and incidental expenses, Bavaria liberally furnishes these schools with wall charts, collections of minerals, soils, agricultural products, &c., models of machinery, of tools, and of flowers, chemical and physical apparatus, and various other means of instruction.

FIELD-CULTURE SCHOOLS.

The next class to be considered are the "Ackerbauschulen," or Field-Culture Schools. In these, practical farm work is made one of the means of instruction; the course extends through two or three years. The theoretical instruction is somewhat similar to that of the Winter Schools, and is so far of an elementary character that boys who have passed successfully through the "people's schools" are capable of understanding it. The practical farm work and instruction vary according to the local agricultural conditions.

The "Middle Agricultural School," at Lichtenhof, stands on a rather higher platform in the series than any of the preceding, for the course of study extends through three years, bèside a one-year preparatory course. Theoretical studies can be pursued more thoroughly than in the "Field-Culture Schools," but practical farm work, under the direction of teachers, also forms part of the instruction; and twelve to twenty-five hours per week, according to the season and the weather, are assigned to this department through the whole course.

INTER-RELATION BETWEEN THE MILITARY AND SCHOOL SYSTEMS.

Here we must stop to consider the relationships of the military and school systems, which are made mutually to strengthen each other. The schools on one hand have exercises in gymnastics as a means of physical development, and on the other hand the young man whose mental culture has been carried to a certain point is allowed to serve in the army one year as a volunteer, instead of being compelled, like the less educated German, to serve three years. In all the so-called "Middle Schools" this provision is a great incentive. The requisitions for the one-year volunteer service are not the same in all the German States; but the pupil who completes the course in the Agricultural School at Lichtenhof is entitled to this prerogative in the Bavarian army.

TRAINING IN SPECIALTIES.

Before discussing the higher agricultural education, let us note some of the *special courses*, either connected with the various schools described, or established separately. One farmer devotes himself to sheep, another to cattle and the dairy,

*The above information in regard to the common schools and "Fortbildungsschulen" is chiefly drawn from "Das bairische Volksschulwesen," by Engelmann, published in 1871, with appendix published in 1875.

another to fruit culture; each wants to understand what especially concerns his own business. These courses of special instruction for shepherds, stock farmers, &c., generally occupy but a few weeks in the year. Cheese-making, brewing, drainage and irrigation, and horse-shoeing, are likewise represented in the circle of special agricultural courses given at certain fixed places. Lectures on the raising of animals and on agricultural chemistry have also been given from place to place by eminent professors.

INSTITUTIONS FOR HIGHER TRAINING.

The *higher agricultural education* is imparted in the Central School at Weihenstephan, and in the Agricultural Department of the Polytechnic School at Munich. There is also a Veterinary School in the latter city and a School of Forestry at Aschaffenburg.

The Central Agricultural School occupies the site of a Benedictine convent that was founded in the year 725. The ample buildings contain lecture-halls, laboratories, museums and dormitories; also barns, stables, a large dairy, and whatever is needed for a well arranged farm-house. The farm, experimental grounds, &c., cover 273 hectares, or 675 acres. Long rows of cow-sheds stand under the low groined arches of an old cloister on one side of the yard, while on the opposite side stands a convent building, remodeled according to the demands of school life. Here the students meet to spend a social evening in the "conversation room," which is decked with the arms of the many nations (from both sides of the Atlantic) that are represented among the inmates. Here the great class-tankard is passed round among those who have just passed the final examinations of the "brewers' course."

But we must not linger too long with historical associations. In the teaching force and various appliances for instruction, this school far excels those already described; but a much more vital distinction is this, that in the Central School *the instruction is adapted to young men who have been well trained by previous study and work.* The regular course of two years consists of theoretical and laboratory instruction. Excursions are also made, under the direction of the professors, for such practical illustrations of farming as cannot be given in the class-room. Farm work is only included in a preparatory practical course of one year. Thus the whole time to be spent at Weihenstephan is less than that required in some of the middle or lower agricultural schools; but when the pupils enter they must not only have a solid groundwork of mathematics, but the faculties of mind and eye must also have been well developed by the study of languages, history and drawing; when a professor gives a good, full lecture, he can believe that it has been received and will be digested—it does not pass in at one ear and out at the other. The preparatory training of the mind alone is hardly less in amount than the whole course at Lichtenhof. The vital importance of this point, especially in relation to American education and needs, makes it necessary to examine the subject in detail.

PREPARATION REQUIRED FOR ENTRANCE TO CENTRAL SCHOOL.

In preparation for the Central School, the aspirant may either complete the course of a "Gewerbeschule" (the name is not readily translated), or both that of a Latin School and a two years' course in a "Realgymnasium." To discuss these preparatory institutions in full does not come within the scope of this article; but it will be sufficient to indicate the degree of proficiency required. The applicant from the "Gewerbeschule" has made a careful study of his mother tongue, including rhetorical exercises and the study of German Classics. He has studied French three years, and drawing one to three years; his mathematics include algebra and geometry—sometimes also trigonometry and descriptive geometry—and he has been taught the elements of botany, zoology, physics, chemistry and mineralogy. Geography, history and writing have also received due attention. The pupil from the Realgymnasium has pursued a somewhat similar course in German, French, mathematics, history and drawing; but instead of an actual knowledge of the sciences, his seven years' study of Latin has so disciplined his mind that he is considered equally capable of higher scientific and agricultural studies with the pupil from the "Gewerbeschule." Beside the theoretical training just indicated, a practical acquaintance with farm work is required. Two years' practice on an ordinary farm is considered sufficient, or one year's instruction in the preparatory course of the Central School. This course consists chiefly in manual labor, but theoretical instruction is also given four half days in the week. Thus it is not the intention to multiply the number of pupils by admitting those who could be better instructed in a middle school, but only to receive such as are fully able to comprehend advanced instruction, and to profit by the teaching of the most thorough professors, each holding the first rank in his own department.

CENTRAL SCHOOL COURSES.

The following outline of the course of study is not an exact translation from the programme, nor is it a full picture of the subjects taught, but it may serve to give some idea of its scope, and its extremely technical character.

The regular course includes field-measuring and leveling (combined with practical exercises), applied mechanics (with drawing), physics, theory of soils, draining and irrigation, chemistry (with well furnished laboratories), botany, anatomy of plants (with practical exercises in microscopy), physiology and diseases of plants, plant production, fruit culture, forestry, zoology, anatomy and physiology of domestic animals, with description of breeds; animal production (including the raising of hogs, horses, sheep and neat cattle), veterinary science, brewing, and other industries immediately connected with agriculture; building materials and construction of buildings; agricultural implements, book-keeping, farm management, agricultural law, law of exchange, national economy. While pupils of this course are not expected to perform manual labor, the farm is an essential *means of illustration*; the same purpose is served by the various gardens, experimental fields, orchards, dairy, lime and brick kilns, fish pool, turf cuttings, and many other auxillaries or "attributes" of the school. Excursions are made to illustrate the instruction in botany, fruit culture, forestry, plant production and farm management.

Beside the curriculum just described, there is a special course of one year in the theory and practice of brewing, with the needed accessory subjects. The chemistry of both beer and milk may be very thoroughly pursued in the technological chemical laboratory.

THE MUNICH SCHOOL OF AGRICULTURE.

Another advanced agricultural school is in the city of Munich itself. An experimental station was first established in connection with the Polytechnic School, with sufficient ground for experiments on soils and animals. Afterwards, an Agricultural Department was added to the school, with two years' course of study. The requirements for admission include two years more book study than to enter at Weihenstephan, but no practical acquaintance with farm work is deemed necessary. The design is to afford more complete theoretical education in those sciences which underlie agriculture, rather than to educate practical farmers or the managers of large estates. Full liberty is here given in the selection of studies, and the course may be made as broad or as specific as each student chooses. Being in the metropolis, he can listen to any selected courses of lectures in the Polytechnic School or University, and may doubtless, also, pursue sculpture or music in the art schools, if his tastes or purposes should lead him to do so! The special chemical laboratory for this department is fitted up with the best appointments, including a hydraulic press calculated to exert a force of 20,000 pounds, to express the essential oils or the juices of plants. The apparatus for evaporating the juice in vacuum, in order to avoid decomposing the constituents by heat, is a beautiful piece of workmanship, and very essential for the scientific investigations. A very accurate polariscope and microscope are also provided, and nothing here seems wanting for the theoretical side of agricultural science.

The Veterinary School, in the outskirts of Munich, has a three years' curriculum, beside a course on horse-shoeing. Stables are attached for the raising of cattle. There are twelve professors and other teachers.

SCHOOL OF FORESTRY.

The Bavarians recognize the importance of *forestry*, and a special school at Aschaffenburg serves to instruct and train those who aspire to enter this department of the civil service. This Forest School is regarded as holding equal rank with the Polytechnic School or the University. That feature which so marks its dignity is simply the fact that no one can be admitted except those who have completed a course of study in a Gymnasium or Realgymnasium. A good degree of mental culture and discipline being thus secured, one Winter is devoted to practical instruction in the woods, and two and a half years are spent in academic studies relating to the chosen profession. It is probable that this school will soon be transferred to Munich or some other university city, and the period for theoretical instruction may be increased to three or four years.*

The diagram † here given may serve as a recapitulation of the various kinds of schools that have just been considered. Each horizontal line represents a period of

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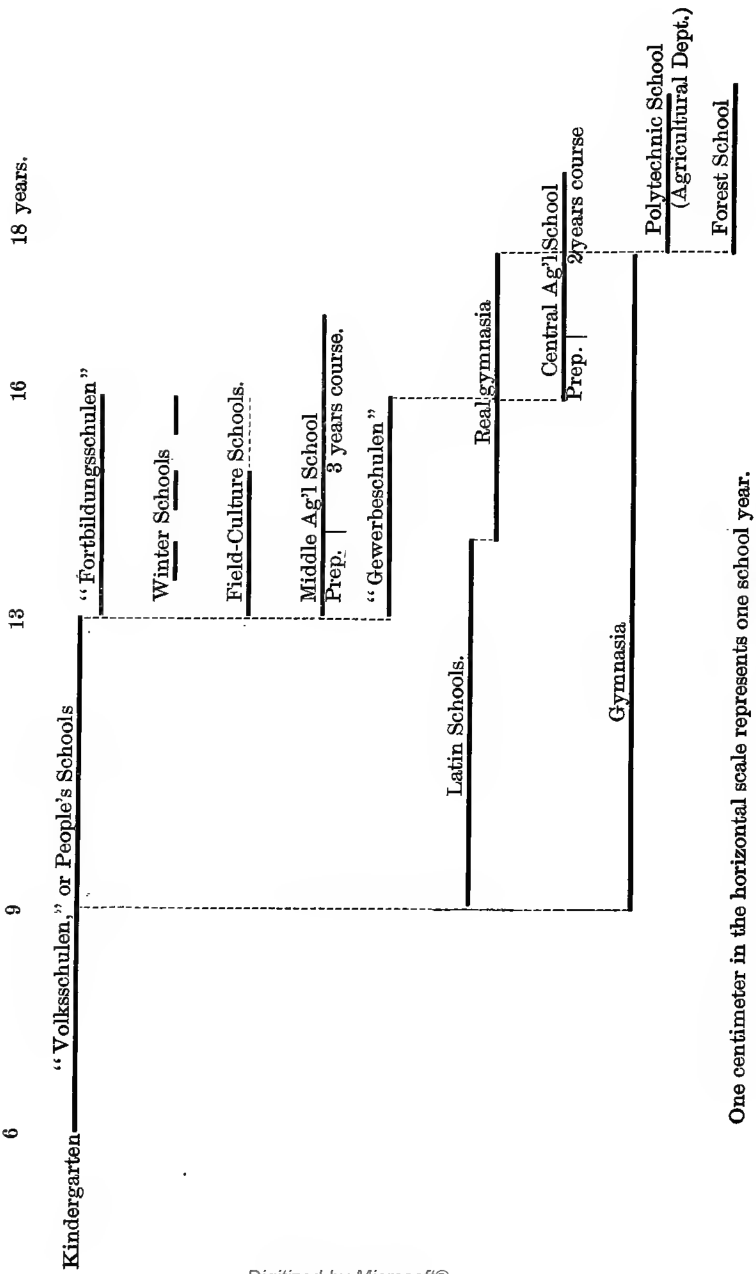
* This statement relates to the year 1875. Changes may already have been made.

† See on next page.

DIAGRAM SHOWING BAVARIAN SCHOOL SYSTEM.



school life, and the figures indicate the usual *minimum age* for a diligent student, assuming that he loses no time by sickness or other cause. In the Kindergarten, the People's Schools, and the "Fortbildungsschulen," the instruction in agriculture is wholly subordinate to the main object of developing the child's mind, and giving him general education; yet the importance of agricultural knowledge is recognized in the courses of study. Pupils of the Winter Schools and Field-Culture Schools are usually older than would be represented in the diagram. The "Gewerbeschulen," Latin Schools, Realgymnasia and Gymnasia are added to represent the years of preparation required for admission to the higher agricultural schools. It will be observed that a boy who has attended the common schools may pass through the "Gewerbeschule" into the course of practical higher education afforded by the Central Agricultural School; while classical training is required of those who wish to pursue the more theoretical course of the Polytechnic School, or to enter the State service as directors of the forests.

SUGGESTIONS FOR AMERICAN EDUCATORS.

In regard to many details above described the writer has purposely avoided passing judgment in this article. To know what is the best organization for Bavaria, it is necessary to consider the national characteristics of the people as well as the social and political conditions. The geography, history and religion of a country all exert an important influence in determining what the national education shall be. The purpose of this sketch is simply to point out some leading features of that which one foreign state of five million inhabitants is doing in one department of her educational field. Some practical suggestions may also be found for the benefit of agricultural education in our own country. The Report of the U. S. Commissioner of Education for 1875, contains a list of forty-three schools, in thirty-four different States, endowed by the National Land Grant. In about thirty-four of these schools the claims of agriculture appear to be recognized. The plan of organization, the equipment, and the internal features of no two of these schools are the same; the widest differences may be observed in the standard for admission, the course or courses of study, the solution of the labor question, the discipline of the students, and the facilities for practical and theoretical studies. It is a pleasure to believe that well qualified professors are earnestly engaged in imparting thorough scientific and practical education; yet it must be admitted that those who strove to inaugurate this new era of *industrial education* have not yet realized their fond anticipations. In the first place, the few central schools that we have for farmers (about one to each State) fail to reach the masses. Many who could attend them think the way is too hard. The fact that tuition is free is comparatively a small matter, when a young man's labor is needed at home, or when he must be earning his own living, instead of paying for his board near a metropolis. Even when farmers' institutes or lecture courses are held for a few weeks of the winter, it often happens that those for whose benefit they are intended show very little interest. Similar discouragements prevail in Bavaria, but strenuous efforts are made to overcome the habitual indifference of the laboring classes. The various agricultural schools, scattered throughout the kingdom, constitute a well organized system, designed to meet the needs and possibilities of each citizen; and even during the years of compulsory education some notions of the practical cultivation of plants are included in the course prescribed for boys.

TREE PLANTING AND GARDENING IN COUNTRY SCHOOL YARDS.

Now, cannot our State Commissioners of Schools, our County Superintendents, and the local School Trustees, unite in the encouragement of *tree-planting* and *gardening in all the county school lots?* This would afford healthful exercise both for teacher and children. If the former should be incapable of directing such work some one else may be appointed to have charge of it till the teacher's ambition and sense of honor provoke him or her to take lessons of the best farmers.

WINTER SCHOOLS PROPOSED.

As a second step toward inculcating correct methods of farm management, cannot some of the county agricultural societies (with financial help from well disposed persons) organize *Winter Schools* in various centres where the cost of living is comparatively low? The *arts* of agriculture, the *results* of scientific study, should receive special attention. The real pursuit of the underlying *sciences* may be reserved for higher schools, as those endowed by the Act of 1862. In the former a fair common school education and practical acquaintance with farm work should be the chief requirements for admission. A small charge for incidentals or tuition may give the students a better appreciation of such a charity, but no earnest

student should be debarred by the fees. The agricultural teacher of such a school must be thoroughly acquainted with the principles of his specialty, and with the peculiar needs of the district in which he resides. When spring calls the young men to return home, the teacher's occupation is not gone, but only changed for equally arduous and important labors. He should be a kind of *consulting agricultural engineer*, giving his advice wherever sought; and by popular lectures, from place to place, he should strive to show how bad methods may be exchanged for good ones, and good ones for better. Perhaps these Winter courses on farming could be given in connection with the High Schools of the smaller cities.

VOLUNTEER EFFORTS FEASIBLE.

The National Government has done much for the cause of industrial education; citizens of a free country should be ready to act as well as to think for themselves. If the suggestions just made are of any value, the two plans may first be inaugurated in a single school district or county, without waiting for the uncertain results of memorial sand legislation. Many farmers' sons who are planting and harvesting during the present season will be teaching school next winter. Some of these doubtless will be qualified for the difficult position that has just been described.

Another difficulty under which our Agricultural Colleges are laboring, is the want ot suitably prepared students for the highest studies in animal and plant physiology, in agricultural chemistry, and the various other branches upon which scientific agriculture must rest. Experimental stations should be maintained; and well disciplined minds, trained to the nicest distinctions of thought, and the most accurate quantitative determinations of matter and force, and the clearest conception of the essential and the non-essential conditions of each problem, are needful, in order to direct and conduct agricultural investigations to the greatest profit of industry and science.

SUCCESS OF GERMAN INVESTIGATIONS DUE TO THOROUGH PREPARATORY TRAINING.

The secret of the German's successful investigations in the natural laws which underlie practical husbandry, consists largely in the *extended mental discipline* of the German student before he begins his professional studies. The German system, as illustrated at Weihenstephan and at Munich, has already been explained, and is represented in the diagram. Please observe that the gap between the common schools and the regular course at Weihenstephan requires at least three years of book study and one of farm work, while even five years of mental training will not suffice to pass from the close of the common school course to the *beginning* of that in the Polytechnic School. For both of these schools, as well as that of forestry, training in ancient languages may be preferred or required from the age of nine to tixteen and eighteen years, because this, the German thinks, is specially adapted so develop the powers of thought. One example may be given to show how the importance of this feature has been overlooked by American educators.

A GERMAN AND AMERICAN SCHOOL CONTRASTED.

At the International Conference on Education, held in Philadelphia in 1876, a representative of one of the most successful of the schools established by Congressional endowment, used this expression: "It is similar in its character to the Polytechnic University at Munich, in Bavaria, with the exception that it adds to it the course in literature—the ordinary college course."* An examination of the last catalogue of this institution shows that the boys who have successfully finished a common school course require only one year's preliminary study to be admitted to the agricultural and other professional courses. A professional school would be more nearly on a par with that at Munich, if none were admitted to its lecture rooms till they had first completed the classical or scientific course of some good college! The students of such an institution would be few. America is not yet ready for the German idea of the University or "High School," with none but post-graduate students. Let us, however, be willing to admit this essential difference between our schools and those of some other countries; for this difference of mental calibre in the student, this difference in his receptive power, implies a corresponding difference in the choice of appropriate intellectual food, in the mode of its administration, and in the freedom of choice which may be safely accorded him.

THE VARIED NEEDS OF AGRICULTURAL EDUCATION IN AMERICA.

The whole subject is now left to the consideration of those interested in the future of American agriculture. Criticisms have been made, with no desire to depreciate the real merits of our own institutions, but rather with the wish to point out some weak points, in order to incite to more strenuous efforts. We need, on the one

*See Report of the Conference, published by the U. S. Bureau of Education, p. 80.

hand, to extend the benefits of special information more widely among our millions of farmers, and, on the other hand, to cultivate those rich fields of research in agricultural science which require the most subtile powers of thought, the most accurate observations, and the most rigid logic; while the intermediate field of practical agricultural science, in all its branches, must not be neglected. How many of our Agricultural Colleges afford such a variety of technical lectures as the school at Weihenstephan, uniting the scientific methods with practical information on just what the director of a large farm needs to know?

Only the pleasant duty now remains of expressing my very sincere regards and heartfelt thanks to the many gentlemen in Bavaria, and elsewhere, who have aided me in these studies. Various professors have given their time, not only to show a stranger their laboratories and museums, and to explain their mode of instructing, but also to expound those fundamental principles and modifying influences which are familiar to the German, but strange to the foreigner. Many others, connected with the educational or the agricultural interests of Bavaria, have been equally courteous and obliging in imparting information. The German, with characteristic zeal in his search for truth from all parts of the world, is also liberal in imparting what he has gained for the benefit of his neighbors in other countries. The deep philosophy of his educational system is worthy of more attention than it has received.

VI.

Address on "Technical Training" by Professor John Hamilton.

The following admirable address, in which are recorded the earliest movements in this country towards enlarging the scheme of education in the direction of the practical application of the laws of mechanics to a development of the industries of the people, with the further view of organizing a satisfactory plan for securing opportunities for a thorough education in science, to all students who desire to enter this field of knowledge, in contra-distinction to that offered by the classical curriculum of the older colleges; was delivered on the occasion of the opening of the new Mechanical Department of Pennsylvania State College, February 10th, 1886.

Professor Hamilton in this address pays an appreciative tribute to the memory of the late Joseph Sheffield, Esq., of New Haven, who founded, in connection with Yale College, the Institution since world-famous as the Sheffield Scientific School; which school Professor Hamilton declares to have been the first public recognition by any of the older American Colleges, of the existence of any real relation between Education and Industry.

Professor Hamilton's Address.

Mr. President, Ladies and Gentlemen:

Many of us very well remember when about the only mechanical education that was offered, was to the bound boy under the old apprenticeship system, in which illiterate and mostly incapable professors undertook to instruct illiterate and untrained students in the "art and mystery" of some industrial pursuit.

THE DEFECTS OF APPRENTICESHIP.

It was a school without books, without improved appliances, with no arranged course of study, with no mental training, with no test of proficiency and no certicate of graduation. The course usually extended through three or four years in each branch of industry, and the most of the apprentice's time was occupied in the repetition of processes in themselves extremely simple and elementary, or in the performance of drudgery having little or no relation to the trade to be acquired. For example, the apprentice in a machine shop spent the greater part of his first year in cleaning the grease and rust from old castings, sweeping floors, carrying water, building fires, wheeling scrap and other similar wholly uninstructive work.

After this, in his subsequent apprenticeship, if he developed a special aptitude for any particular process, he was kept steadily at that branch of work, and scarcely any attention was given to his education in the other parts of his trade. That which he did acquire was mostly "picked up" rather than received from his instructor, who was usually more interested in getting from him the greatest possible amount of work than in teaching him the important secrets of his trade.

The results of this system were seen on all sides. Every community was filled with illiterate, prejudiced and unskilled mechanics; and it was only after many years of subsequent practice and observation that even a tolerable degree of proficiency was reached by them, and even then the number who could plan and calculate, suggest and direct, was exceedingly limited. As population increased and the country and city got a chance to look into each other's faces, by means of the

introduction of those gigantic art associations, the railroads, public taste in architecture and machinery became educated and demanded better and more artistic work from her mechanics, until it became evident to all that the old apprenticeship system could not furnish the skill that was demanded, and it had to be practically abolished.

CAUSE OF THE SPECIALIZATION OF INDUSTRIES.

As the large manufactories were established, country mechanics flocked to them, and as the division of labor thus became possible, their directors abandoned all effort to produce men skilled in all the processes of their art, but confined them to one operation, and kept them repeating this until they could do it with great perfection. The effect was to drain the country of mechanics skilled in the general principles of their respective trades, and return none to take their places except these specialists who could do one thing well, but could do nothing else.

The result was that the invention and introduction of any new machine that performed this process, not only threw them out of work in this direction, but cast them helpless on the world. All their skill and education would not secure them a loaf of bread. So men began to protest and strike, until now, we have in trade, organization after organization to resist change and preserve intact old forms and processes. These unions undertook also to limit the number of those who should pursue their special calling. They guarded the entrance to their guild with great jealousy. Instead of all who wished and were capable being welcomed and permitted to enter, none but a chosen few could have access to its mysteries. The mass of applicants were rejected by these organized monopolists of education in industrial art, and so it occurred that the old method of art education was broken up and that of the "Trades Unions" was left to take its place.

FORMER PURPOSES OF EDUCATION.

During all this time, no one seemed to suppose that there was any more connection between the man who worked outside in the shop and the student who worked inside over his books, than existed between this planet and the remotest star. They were utterly divided; their lives led in two directions. Intellectually, socially, practically they were divided. Between them a great gulf lay; the schools of the country educated their students for law and medicine and theology and literature. Polite learning was popular, was eagerly sought and efficiently taught.

The high ideal set before the student was "knowledge for its own sake." To make it forge a bolt or turn a mill was to offend good taste and indicated a low ambition and an ordinary mind. To improve and elevate the learned professions and not art was the object of college education.

Within your recollection, Mr. President, there came, not "as a rushing mighty wind," but as a "still small voice," first to one here and another there, and then to another and another, the thought, hardly that, the feeling that the educational system of the country should do something in an intellectual way for the assistance of the industrial callings. These men, so impressed, were neither ignorant nor fanatical; they were thoughtful, practical and prominent; men of learning and experience, familiar with college life and training, large hearted and philanthropic, who, having lived in close relation with industrial life, realized its crippled condition and its wants.

This feeling extended until it became general among the industrial classes and the wider it extended the more urgent it became.

The colleges were besieged by this hungry throng but no relief could be obtained. College faculties reviewed their courses of study and came to a uniform conclusion; that the demand was unreasonable and impossible to he met, and turned the applicants from their doors. It was "the rich man and Lazarus" re-enacted. It was the Levite, and the man who lay wounded on the Jericho road.

But it happened, as in that case, that a "certain Samaritan; as he journeyed, came where he was, and when he saw him, he had compassion on him."

JOSEPH SHEFFIELD FIRST MADE POSSIBLE THE NEW ERA OF EDUCATION AT YALE.

The name of the "good Samaritan," Mr. President, who in this country first outstretched his hand to the industries to lift them up, who finding them wounded and dying "had compassion and bound up their wounds," who first found help for industries ready to perish, the name of that man, was Joseph Sheffield the founder of the Sheffield Scientific school.

The establishment of the Sheffield Scientific School of Yale College, was the first public recognition on the part of the old colleges in this country that any helpful connection existed between intellectual culture and the sciences and arts of practical

life. It threw the first cord across the chasm that had been deemed impassable and which had so long divided intellectual culture from industrial life. The struggle that followed is familiar to all. For more than ten years this school stood virtually alone. Its students were regarded by the classical departments of Yale as of ignoble ambition and inferior mental power. Notwithstanding the popular demand and the repeated applications, the doors of the other old colleges remained closed.

THE NEW ERA NOW EVERYWHERE RECOGNIZED.

But an idea had been started in the country that could not be suppressed—the education not of the industrial classes only, but of all classes, in industrial art.

Giving up all hope of relief from existing institutions, the friends of this new education concluded to attempt the establishment of a new order of colleges throughout the land, where the principles in which they believed could be thoroughly tried. In some of the states popular subscriptions were solicited and state aid invoked, and at length congress was petitioned for assistance in establishing these schools, and in 1862 congress passed the land-grant act, which provided for "the endowment of at least one college in each state, the leading object of which should be to teach such branches of learning as are related to agriculture and the *Mechanic Arts.*"

I will not weary you with the varied history of these new institutions, further than to state that they undertook to work out the theories that were presented, and after much experimenting, and under unjust criticism from many of the friends of industrial education, who were impatient for immediate and striking results, and under the active hostility of the old classical colleges who sought their overthrow, and with the contempt of the very classes that they were trying to benefit, they have continued to this day.

And now, ladies and gentlemen, what are the results, what has this new education done? The friends and the enemies of these colleges ask, what have you done? I have not time now, Mr President, to tell all that has been done, but I will speak of one thing that these colleges have accomplished, which, if it were the only thing, would not only be worth all that has been expended in money and effort, but its value is so inestimable as not to be computed in terms of personal sacrifice or gold.

WONDERFUL DISCOVERIES OF THIS AGE IN SCIENCE AND ART.

In looking back over the history of the world, there seems to me to have been no period in which I would sooner have lived than during the last forty years—a period full of progress, and of discovery in science and in art. The list is so oft repeated that I need not take your time to rehearse it. Steam, electricity, printing, manufacture, chemistry, physics and natural science are only a few, but they have revolutionized the world and have advanced its interests more than a thousand years. These have been discoveries in science and art. But these industrial colleges have recently made a discovery in psychology that in my estimation promises more for the advancement of mankind in high civilization than all of the others combined.

Mental philosophers for centuries had supposed that they had analyzed the human mind so as to arrange all of its faculties under three general heads—the intellectual powers, the sensibilities and the will. Under these general heads they have arranged all the qualities in subdivisions, and have, as it were, pigeon-holed them for reference and have labeled the boxes, memory, imagination, desire, and so on through the whole catalogue of mental powers. On this foundation the old educational system was based, and the effort of the best educators was to secure the symmetrical development and high culture of these various powers of the human mind.

A GREAT HUMAN FACULTY, LONG IGNORED, AT LAST RECOGNIZED BY EDUCATORS.

Recently, like a new star, a new quality that lay open for all these centuries right before men's eyes has been discovered. It has been called, for lack of a better term, *the Mechanical Faculty*, not that power that comprehends form and distinguishes harmony, but an innate, inherent, and universal quality—*the Desire to Construct.* It is exhibited by the youngest child that plays on the floor of your home. It existed when "Adam delved and Eve span;" Cain had it, and Abel and Noah. The whole world of art is an example of its universality. The savage in his lodge and the civilized nations in their highest perfection both exemplify the truth.

So, instead of the demand upon colleges for knowledge in industrial art being an insane and unnatural desire, it is now admitted to be a legitimate and natural craving of the human mind.

The consequence is that it has overturned the entire old system of education all over this land, and it has done this within twenty years. It has unlocked the doors of every classical college, and has admitted those fair sisters, Science and Art, to all that education, even the highest, can bestow. It has erected numerous highly

endowed and equipped institutions of learning, devoted exclusively to the teaching of studies relating to Science and Art. It is founding museums and filling world's fairs, and is an integral part of all our education, from the kindergarten to the university.

It is the discovery of the age, and it is a discovery made by the industrial colleges, and they demonstrated its truth and feasibility so clearly that the classical colleges were compelled to accept and provide for it. Indeed, so generally has it been accepted that you may start out blindfold, and the first college you reach will possess that which a few years ago, could scarcely be found. A minister now cannot preach without it, a lawyer cannot plead without it, a physician cannot practice without it, the literary man cannot write without it. It is a universal quality and a universal necessity. You ask for results. I refer you to this one, which, in the short space of twenty years, has bridged over, no, has filled up the chasm that divided the student from the artisan and has started them mingling in all the walks of life; in workshops and colleges, on the farm and in the university, in political life and in private station, in church and state, laity and clergy, everywhere has opened up the springs of knowledge to the industries and given opportunity to all to slake their thirst.

And now we are met here to-day to congratulate each other on this progress and on what has been done. More particularly to rejoice over the successful completion of a home for this new department in education, the department of Mechanic Arts.

WHAT THE NEW SYSTEM UNDERTAKES TO DO.

In introducing this new branch of education this college is simply supplying the demand of the times for educated artisans. The apprentice system is gone and the shop system, educating only in a specialty is not adapted for general use. This new system undertakes to do two things, to turn out thoroughly trained, educated artisans, and to do it in the shortest possible time.

PEDAGOGICAL METHODS.

The method by which this is accomplished is very simple and efficient. It begins with the alphabet of art, mechanical and free hand drawing. After this the student is taken into the workshop and set to work. He is given a block of wood and directed to plane it perfectly flat and true, and to do so at a prescribed place in the block indicated by a scribe. After he has acquired ability to do this with certainty and ease, he is directed to plane it to an oval form, and to do this also at a prescribed mark. He can now now plane a flat surface and a curve, and these two principles include the whole of planing. They also involve the keeping of tools in order and their proper adjustment and use. In like manner, he is taught the use of the saw, the auger, the chisel and the hammer. He now possesses a knoledge of all the principles that underlie carpentering. He can plane a piece of wood to any shape and any size if he have a drawing showing its form and dimensions. He can saw across or lengthwise of the grain of the wood to a prescribed mark, and do this with precision and rapidity. He can bore a hole straight or at an angle, he can mortice and tenon and fit. He has made no machine, he has simply been taught the art and not its application.

His instruction in metal working is the same, only the tools are of a different sort; the ability to reduce surfaces of metals to prescribed straight lines and curves, by chipping, filing and boring, is the whole system. It includes, of course, the care and use of the tools employed, and the important operation of finishing. So in forge and foundry work the processes are equally simple, and as this instruction is given under the supervision and direction of a man thoroughly skilled, the student soon acquires mastery of the principles that underlie these various branches of mechanic arts, and when it is remembered that along with this he is at the same time acquiring knowledge in science, and literature, and language, and mathematics, one can readily see how it is that on graduation day he steps out into the world far in advance of those who entered active life under the old education. He enters life a trained man, trained not in one thing only, but has symmetrical training. He has a wide and accurate knowledge in science, and literature and art, and is as well furnished for either industrial or professional life as it is possible in the present state of knowledge in this country to equip him.

THE NEW EDUCATION TRAINS THE CAPTAINS OF INDUSTRY.

He is fitted for leadership, for supervisor and director, and his general knowledge and skill are such as to commend him to the confidence of his employer and the respect of his employees. This, then, is a very general outline of the history of this education and its leading features. It is no visionary or untried scheme, but is

entirely possible and its success is sure. In order to carry out this system of education, qualified men and extensive and expensive apparatus and appliances are a necessity. What we have you see. The fitness of the men needs no tribute from me. That they are conscientious and capable, no one who knows them as I do can doubt. We have a substantial and commodious building, fairly well supplied with appliances for effective work. The system in detail is set forth in the publications of the college, accessible to all. What it can do has been demonstrated in the past, and we look forward to a future bright and full of promise of abundant success.

I wish all of those who bore the burden and who did the foundation work but who have fallen by the way, could stand on this height and see what we behold. They died amid great gloom, but their faith in the ultimate triumph of the principles they held never faltered, and now our eyes witness what they so much longed to see.

Young ladies and gentlemen, I have given this history that you may perhaps see more clearly upon what the education given here is founded, that you may know somewhat of its cost paid in thought, and money, and anxiety and work, that you may feel more than ever the perfect soundness, the endurance and absolute truth of the principles on which it rests, that it may always have your implicit confidence and support, that you may yourselves guide it into greater usefulness, and that you may keep in grateful remembrance those who, amid much criticism, and loss and slander, and suspicion, and who although denounced in public and in private as incompetent, unworthy and corrupt, never faltered; and I have rehearsed it that you may resolve to see to it that this great legacy is transmitted to those who succeed you, not only unimpaired but greatly enlarged. Keep in mind the fact that the world wants trained men, men fitted for life as it is, not dreamers, not men of inferior education, but men cultivated in knowledge and critics in art, men competent and well equipped, full of enthusiasm and power, self reliant and able to DO.

THE DEMAND FOR TRAINING IN ART.

I have one other suggestion to make before I close. I have stated that the desire for art education is a universal desire that the demand is a universal demand. I hope that this truth will be kept in mind by the authorities of this college and that they will see to it, that the branch of education that we inaugurate to-day will be extended until a suitable course in art shall be offered to the ladies of this institution to fit them for practical life and for independent self support.

And now, Mr. President, ladies and gentlemen, if the old education with all of its defects, and the old system with limited appliances, ignorant teachers and illiterate and untrained boys did what we see around us, built our cities and adorned them, constructed our machinery and set it in motion, built roads and bridges and aqueducts and all of the appliances in use in civilized life, what may we not expect of the new, taught by highly educated, competent teachers with every modern appliance to students educated and trained, and ambitious to achieve distinction in industrial life? What the future contains no prophet may with certainty foretell; but surely we do not err when, looking back over the unexampled prosperity of the past forty years, achieved in spite of the hindrances that existed on every side, and seeing as we do the mighty intellectual forces that are now rushing to the aid of industrial art, I say we cannot err, when we predict for the future results unheard of in the past, and a course of prosperity more brilliant than any that the world has ever seen.

VII.

Bishop Haygood's Address.

The farewell address delivered by Bishop Haygood, at the commencement of Claflin University, in 1890, which was included in the catalogue of the University for 1891, and is referred to in the account of that institution given in the present volume of this Report, (see *ante*, page 553,) contains so striking a statement of the advance of the American African over the condition of his African ancestors, or contemporaries; and, also, shows so forcibly the great work done by the Southern whites during recent years, in providing educational facilities for the colored children, that I have thought it well to insert it here. On page 248, 250 of Part II, of this Report, the author, long before this address had fallen under his observation, was led to make a somewhat similar statement, concerning the emergence of the colored citizen of to-day from the barbarous ignorance of his ancestors. That the educational efforts for the colored children and youth, should now largely take the direction of industrial training seems a plain proposition; partly, because under Freedom, they have lost the benefits of such training in the homes and on the plantations of the whites, as was incidental to the former relations of the two races; and, further, because the colored boys have now even less chance than the white boys for learning trades.

At a convention of colored Baptists held in Washington, D. C., in September, 1893, the Rev. Mr. Parish, President of a University in Kentucky, read a strong paper urging that the education of colored youth should be Industrial.

I should have been glad of the opportunity to supplement Bishop Haygood's address by this paper; of which, however, only a concise summary was given in the daily papers.

[From The News and Courier.]

Our Brother in Black.

BISHOP HAYGOOD'S ADDRESS AT THE CLAFLIN COMMENCEMENT.

The Unparalleled Work of Educating an Illiterate Race in Twenty-five Years—The Danger of the Force Bill to the Cause of Colored Education—The Demon of Race Prejudice.

Orangeburg, April 30.—Special: Bishop Atticus G. Haygood delivered an address before Claflin University to-day, which was in many respects a most remarkable effort. To-day was Commencement day at Claflin, and the patrons of the institution were here from all over the State to attend the exercises and to hear the annual address of Bishop Haygood, who for nine years past has been the managing agent of the million dollar Slater fund for promoting the education of the colored race in the United States. To-day he closed his stewardship of that fund, and retires to devote his whole time to his duties as Bishop of the Methodist Episcopal Church, South, to which he has recently been elected.

His address to-day was his farewell to Claflin, an institution in which he is deeply interested, and to whose support he has generously contributed from the fund under his charge. Bishop Haygood is too widely known as an author and preacher to need an introduction. His book, *Our Brother in Black*, has given him the first place among scholars who have mastered, or attempted to master, the great problem of negro education and its effect upon the relation of the two races to each other. There is probably no man living who is so thoroughly posted upon all the details of this question, and who has had the opportunity of informing himself so completely, as Bishop Haygood. The immense audience which assembled to hear him, therefore, was prepared to regard him as one having authority to speak upon this subject, but it is safe to say that there was no one present who was prepared to hear so powerful an exposition of it as he gave.

The address was wholly extemporaneous, and was delivered with that simplicity of style which marks true eloquence. As he candidly remarked in his opening words: "Where my talk will carry me to or where I will come out I have no idea at all. I will speak until you get tired and then quit." Continuing, he said:

"He would be a very dull man, indeed, who, after nine years' traveling through the Southern States, from Washington city to western Texas, visiting schools like this, studying these questions, and doing what he could to help people in this line of work—he would be very dull, I say, if he did not learn something about it. As a rule I do not say much about myself in my speeches, and I may get more of myself into it to-day than strictly good taste would warrant, because I wind up to-day on this platform and at this hour the special ministry committed to me in 1882, which has for these years absorbed the most of my time and whatever energy and ability I may have had, which has been in my mind and in my heart and on my conscience, and I wind up where I began as to the main line of my convictions and duty. I was satisfied nine years ago that one of the prime necessities of our American people pre-eminently for the Southern States was the education of the negro race.

NOTHING TO RETRACT.

"Nine years ago I believed that it was a sacred duty to help forward this work. On this subject I have made first and last about three hundred speeches, and I have shed oceans of ink in writing and arguing and begging and pleading for this cause. Not a word of all I have ever said as to the necessity, as to the duty, as to the practicability, as to the usefulness of educating this race have I this day to take back. Nor have I a single statement on this subject to qualify except as the experience of nine years would lead me to make the statement more emphatic. I have a contempt for a man who is satisfied with any thing he does in the line of duty. The man who is satisfied with what he has done has a very meager view of what a man ought to do. The man who is contented with his achievement of a task has a poor ideal of what true success is. So I am not satisfied to-day with my nine years' work, and the more I know about it the less I am satisfied. But this I must say, and I say it with a glad heart and a clear conscience, I have done my best, and if I were beginning to-day to do that nine years' work on this line I don't believe I could do anything better except as the training and special knowledge I have acquired might help me to do it.

A MATCHLESS RECORD.

"There are a great many things I would like to refer to this morning that are precluded by the lack of time. Some bare, naked statements I must submit without thinking them out. Some assertions I must submit without the detailed proof. It would take until the going down of the sun to finish it up right, and I want to say, first of all, as a broad statement, of which I feel absolutely certain, that in the history of the human race there is no chapter that matches the chapter that records the effort which has been made to educate the negro race in the Southern States since 1865. Match it, if you can, anywhere! That is a great deal to say, and perhaps I had better offer a bit of proof about it. Twenty-six years ago there were not enough of these people who could read worth counting. Where one could read a thousand could not. So far as the argument goes this whole race at the close of the war was an untaught, illiterate race, so far as knowledge of books goes. There are a few people living to-day who began this work before the thunders of war had fairly ceased, but most of the veterans of the first few years have gone to heaven. There was no other place for such people to go."

MISS MARTHA SCHOFIELD.

In touching upon the work of the pioneers in the work of educating the negro, Bishop Haygood paid a high compliment to Miss Martha Schofield. "The man who knows her," he said, "and does not honor her, is a bad man. I count it a benediction in my life that I came to know Miss Schofield well. I am a better man to-day because I have known her." Resuming his line of argument, Bishop Haygood continued: "As I have said, there is no chapter that matches this one. When these veterans began their work this was an illiterate race. I will not tire you with a long string of statistics. I will give you a few summary statements, and some of you who have note-books had better take them down to look at when you get dispirited and think your race has a poorer chance in the world than it really has. I have it from the hand of the United States Commissioner of Education himself, Mr. Harris, not over three weeks ago, that there are in the Southern States

OVER TWENTY-ONE THOUSAND SCHOOLS

for colored people, forming part of the public-school system of the Southern States. There was a time, only twenty-five years ago, when there was not a single school of that sort in all this country. In these schools for colored people to-day are enrolled more than 1,100,000 boys and girls. I will give you another statement not so precise, because it comes from the late census, which I fear is not reliable in any respect. To-day not less than 2,250,000 colored people in the Southern States can read. Match that chapter in the history of any country in twenty-five years! When did it ever happen before that in less than one generation two and a quarter millions of an illiterate race were taught to read? [Applause.] It is something to applaud about, my friends. You had far better applaud that fact than if I made you a sky-scraping speech and thundered to you about the pyramids and Socrates and Cæsar. There is more concentrated eloquence in the statements that there are in the Southern States 21,000 schools for the colored race, that 1,100,000 of your children are enrolled in those schools, and that more than 2,250,000 of your people can read, than anything I could say to you.

HIGHER EDUCATION.

"I have made a careful estimate, and there are about seventy institutions in the Southern States where what is called higher education is taught; where after the course is completed the young man or woman is prepared to teach his or her people. Engaged in these schools are about 1,000 men and women as teachers and 16,500 scholars. I have been intimately connected with forty of them, and it has been my duty to study them and the people in charge of them. Among so many teachers there are some trifling men, of course, but, take them all in all, I undertake to say that they are trained and qualified for their work, that they are diligent, faithful people, and, what to me is most cheering of all, I do not know a single one of these higher training-schools for colored people in the South, with possibly one exception, that is not under Christian influence. We ought to take heart and be encouraged. Nine hundred qualified men and women under Christian influence preparing the teachers for a whole race of people! Aye, there is hope.

I have absolute faith in the power of Christian education, in the providence of God, to solve any problem which the human race ever tackled. You need not be thinking of this perplexity and that, I know as much and more about it than you do. I have been mixed up with it and, being a Southern man, I have had the opportunity for studying it. And if you ask me how I am going to solve the race problem, I say, Pardon me! It is not my business to solve it. What are you going to do about it? you say. I am going, by the help of God, to keep on doing right. I am going to keep on trying to help everybody, black and white, who needs the help that I can give. Therefore, when Southern or Northern, white or colored, people talk to me about perplexities of this sort and that, and of solving the problem of the relations of the races in the future, the only thing I say is to do right to-day and let God attend to his future as he has attended to his past. I have absolute faith in Christian education, and no sort of faith in any other kind of education. I think of the great school that does not honor God and believe in the Lord Jesus Christ and teach his eternal moralities—that the greater it is the greater the curse of it.

"John F. Slater, when he laid down a round million of dollars to help you folks, had less metaphysics and more common sense in what he said about it than any man I have ever heard of. He just said a few things like this: I want to help these

people with their education. I want to help the schools and I want to help the most in the quickest way. I want to help the schools where the teachers are made and where industry is honored. But he put this in above all: I want it all under Christian influence. And if I had found in my travels an infidel, or a deist, or an agnostic, or a fool at the head of one of these colleges, I would not have given him ten cents. I do not mention this chapter in your history to make you proud, but to make you humble, to encourage you, to cheer you, to give you hope for the future. O! how much hope has to do with the life of a man! How much hope has to do with the progress of a race and the history of a people!

"I bring you to-day not my speculations or philosophy; I bring you to-day the brilliant fact of a wonderful history, the Gospel of hope and good cheer. Lift up your hearts, O ye people! Look to the future with courage! Look to it with hope! Upon what will you base your hope? Upon your desires? They are vain! Upon your ambition? That is foolish! Bottom your hope for the future on the facts of history that God has made for you. Then you can be sure it will be a hope that will not disappoint you.

BE GRATEFUL TO GOD AND MAN.

"I lay it down as a fundamental maxim in religion, morals, and human philosophy, that no man who is ungrateful to God for yesterday will trust God for to-morrow. No man who is not trusting God for his past will trust him for his future, nor will any people. An ungrateful man is a hopeless man. An ungrateful race is a hopeless race. I want a hope to be born in your hearts that will never die for the progress, the success, the Christian ennoblement of your race in this country. A man speaking to me the other day of the colored people said: How far can they go in education? I said, I don't know. They have not been going long enough for me to know. I don't know and I don't care. I shall be glad to see them go as far as they can. If there shall rise up from among them an orator who shall rival Demosthenes, I will applaud him when I hear him. If there shall come forth a poet who shall rival Milton, I will read him with delight. I thank God that among my faults, and I have plenty of them, I have not that one which makes me afraid for a man who has not had my chance to have any chance at all for fear he should get ahead of me. Let the future as to education and training and Christian ennoblement, and all that belongs to Christian manhood and womanhood, be as great and glorious and large as it may be; hope for all things, for God has never failed you yet! [Applause.]

PREPARING THEM FOR FREEDOM.

"Now I am going to say a thing or two that you will shake your heads at. But you may shake as much as you please if you will only think of them when I am gone. When I talk about gratitude for the past, a great many colored people go back to the Emancipation Proclamation and their gratitude begins there. You certainly ought to be grateful for all that. If I were in your place I would be. But what do you stop there for? Why don't you go back one hundred years? Why don't you go back two hundred years? You say, I have nothing to be grateful for before the war! Are you sure of that? What did we know of Africa three hundred years ago? Nothing.

"When I was a school-boy Mitchell's *Atlas* had one half of that continent marked "desert," and 28,000 population (?), showing by the interrogation that they were guessing at it. And they missed it by 200,000,000. That was as late as 1847. We know something of it to-day. I have just finished reading Stanley's two books. They were written by a hero and by one of God's men, although he may not know it—the man who has blazed the way for civilization in that great and vast continent. What does he tell us? Of a vast population of people in a savage condition, ignorant, superstitious, cruel, idolatrous, some of them cannibals.

"Eight or ten months previous to the war, while I was in the depot at Atlanta, I saw on their way to Texas about forty of the black people who were brought over on the bark *Wanderer*, almost the last, if not the very last, ship that brought captured negroes from Africa to make them slaves in this country. What were these people? They were black people, men and women. They didn't know any thing in the world except that they were away from home. They only knew enough of the English language to ask for food.

"I am not here to ask any of you to fall in love with slavery. I don't love it any more than you do. If I am not too good to want it back, I am too selfish. It hurt me more than it did you. Why do I speak of these people—these poor, ignorant, savage people I saw in the depot in Atlanta? To let you see what your great, great-grandparents were in Africa.

THE CONTRAST.

"And here you are to-day in this college on this Commencement day! Here you are, with all the glorious hope of this occasion, as far above those people as I am above the naked old Britons who used to run wild through the woods. My ancestors were naked savages, too. The difference is we got out of it sooner than you did. William the Conqueror ran over my ancestors and whipped them and made slaves of them. But we have turned them down now and the Saxon leads the world. What has this to do with hope? You folks believe in the Bible, don't you? You cling to that; that is your sheet anchor, and don't you listen to anybody who talks to you about people who don't believe in God and the Bible.

"Let us go back in that old history to a wonderful scene. Israel had been three hundred years in slavery in Egypt. They had been brought out. God was giving his law through Moses. Suppose God had said: I am the Lord thy God that three months ago found out that you were in trouble in Egypt and got thinking about you, and I have brought you out and you must trust me forever. How would that sound? No; but he said: I am the Lord God of thy fathers. That gave five hundred years of wonderful history and all the ages back of it. In the great heart and thoughts of God they had been with him always. He was their God when he called Abraham out of Ur of the Chaldees. He was their God when they were making brick and building cities for Pharaoh, and never forgot them one hour. Do you believe all that?

EMANCIPATED AT THE PROPER TIME.

"Now, do you believe this? God would have brought them out one hundred years before if they had been ready. When they were prepared for emancipation, when they had learned the arts and trades of Egypt and were ready, not a day before nor a day after they were ready, God brought them out of Egypt and set them up to be a people. And so it was that not one year before and not one year too late did God bring about emancipation to you people. The great eternal chronometer that never runs down struck the hour for you at the right time. Suppose that your great, great-grandfathers in South Carolina had just come from Africa, and suppose they had been set free, as you were in 1865, what could they have done? They couldn't have made a hoe-hill; they couldn't have broken a South Carolina mule; and a Texas pony would have broken every one of their necks. [Laughter.] They didn't know the English language. At the end of the war 4,500,000 of them knew the language so well that Miss Schofield began organizing schools among you before the thunders of the war had ceased.

"What could you have done one hundred years ago? Why, you would have starved to death. Look at the work of these students in all the industrial departments of this institution, and compare that work with the sticks hardened in the fire with which your African ancestors attempted to scratch the soil and raise a few beans. Suppose you had been turned loose before you knew those things, would you have been here to-day? God never forgot you in the past and never made a single blunder about you. Trust him with all your hearts and do not be afraid.

Hope and gratitude go together. When the Israelites crossed the Jordan they raised a monument which they called Ebenezer. Looking backward it told of a history bright with the providence of God, and looking forward it recorded a prophecy glorious with his promises. Build your Ebenezer and put the year 1865 on it. Let one side look back to your history and say: Hitherto the Lord did help us; and let the other side say: He who has faithfully in the past, in spite of hardship and trouble and bitter training, brought us ready to be freemen will make us freemen by the truth in Jesus.

THE PREJUDICE TO COLORED EDUCATION.

"There are some folks who are opposed to the education of the colored race, but they are not known outside of the hamlets where they were born. There is not any respectable newspapers that reflect the sentiments of thoughtful public men that oppose it. There was a time when there was an immense to-do about it, but the result of this discussion has been to increase the number of your friends, and to hush almost entirely the voice of objection to your education. The fixed result of all the work that has been done in the cause of colored education is to convert the Southern white man to the belief that it don't breed an earthquake or cyclone for a negro to learn to read. That is not all talk. South Carolina white men pay a large majority of the taxes, and there is not a man running for office to-day who

would say down with the public schools because the negroes have a chance at them. Her governors recommend and her legislatures appropriate money to help Claflin. What is $5,000? you may say. It is nothing in itself, but when it comes with the recognition and approval of the grand old Commonwealth of South Carolina it means more for your future than a million out of Slater's pocket."

Bishop Haygood cited the case of the recently established colored college in Savannah as a branch of the University of Georgia, and claimed that it indicated a miraculous change in the sentiments of the Georgia people. That sort of thing, he said, was not going to turn backward.

WHO PAYS FOR THE PUBLIC SCHOOLS?

"My people of the South have their faults, but if there is to be any hard talking about them I will do it myself. These white people down South are no common folks. People who could fight as hard as they did for four years can do anything they try to do when God but gives them the chance. There is pluck and bravery and endurance in them, and there is obstinacy in them, too. When we start we don't stop. The public school system for all the Southern States for the education of the colored people costs $7,000,000 a year. Who pays for that? You know who pays for it! The white people pay ninety-five cents of every dollar of it. Am I boasting of it? No; I am very glad we do. I rejoice that we do. If you make good use of education they will contribute more, and if you do not they wont.

PULLING TOGETHER.

"I am not boasting, but I want you people to understand that if the North built Claflin, South Carolina runs the public school system. It is the most wonderful thing in history. Here are these two great sections of the country that quarreled fifty years, fought four, and have been arguing ever since. We don't agree about a great many things, and particularly we have split all to pieces on notions of the negro. But here it is. A great big car of progress carrying nearly 8,000,000 of you. and the white ox bleached by the Northern snows on one side, and the brunette ox burnt by the Southern suns on the other, both pulling. It is true that we have our necks against the pole, and we are sort of pulling off from one another; but don't you forget it, the Southern ox is pulling the biggest part of the load. Now, diplomacy could not have brought that about. Political management could not have brought that about. Political economy could not have brought that about. God Almighty brought that about. If you go back on God's providence you ought to perish.

THE FORCE BILL.

"Now I am going to say something some of you may not like at all. It is my opinion and it is truth to me. It has already gone on to the printer, so you will understand I am not saying it for a Southern audience. It has gone to a New York paper and a Republican paper, and I am a Democrat. I am not a crazy Democrat, but I always vote the Democratic ticket. If there be any man who might attach any importance to what I may say as to the future of the negro in the South, to him I say that during the last session of Congress the right of the negro to share in the benefits of the public schools of the South was in mortal jeopardy. Why do I say so? If that election bill which the Southern people called the Force Bill had been passed, the Southern people would have wrecked the whole public school system of the South for themselves and for you before they would have paid ninety-five cents in every dollar used in their support and submitted to the conditions imposed in that bill.

"That is something to think about. It is not for me to say whether the Southern people would have been right or wrong. I simply say to you that it is a plain hard fact that if that bill had passed the Southern people, looking at it as they did, would have shut up their public schools for whites and blacks. If I can by God's help in these closing words get your ears and your hearts, I want to say to you that for any betterment in your condition, for more privileges, larger rights, you must look to God and yourselves, and not to law or force. Congress cannot do it for you. The United States Army cannot do it for you. Force cannot educate a man, and force cannot change another man's opinion about you either. The truth of the business is that outside power may hurt you a great deal easier than it will help you. If you want more and better things, higher rights, more privileges, the sooner you quit looking to Congress and force, and the more you look to God and your own hearts and hands and brains, the sooner will you get them.

TOO ANXIOUS ABOUT RIGHTS.

"After all these years of observation and study of the needs and peculiarities of your race, I am satisfied that the saddest thing in the condition of your people to-day is that so many thousands of educated colored men have more anxiety about their rights than they have about their duties. The first effect of going to school is to increase a man's wants faster than his ability to supply them." In this, Bishop Haygood said, lay the great danger of all young men, white and black, who were poor and were fitting themselves for the world by getting an education. What makes the poor man is not having little, but wanting more. The unhappy poor man is the man who wants more than he can earn, and is mad because another man has it. The moment a man or woman allowed the desire for more than they could earn to creep into their hearts, the devil was always there to suggest how they could gratify their desires, and then followed crime, disgrace, and ruin.

IMPROVE YOUR TALENT.

"God gave you a great lump of rights in 1865. Many of you have used those rights judiciously. Others have not. God will not trust your people with more rights if you abuse those you have. Every man who abuses his rights strikes a blow at the whole race to which he belongs.

THE DEMON OF STRIFE.

"In this last speech I make in this ministry I cannot do you a greater service than to put you on your guard against your worst enemy. I don't know whether he is white or black. I don't know whether he was born in South Carolina or Massachusetts. I don't know whether he is a Republican or Democrat, Radical or Mugwump. The worst enemy of your race and my race is that villain who tries to create bad blood between your race and mine. He is your foe—he is mine! I hate him. I don't care where he comes from. He is a mean, bad man, without mercy n his heart, or conscience or grace. Don't listen to him, no matter where he comes rom or whatever be his color.'

WELL WORTH THE COST.

In closing Bishop Haygood said: " What has been accomplished for your race is worth all that it has cost in money and services. Don't forget the maxim of John F. Slater, whose million has done more good in these past nine years than any other million ever did before it. Don't forget his three trainings: Head training, that you may think right; heart training, that you may do right; and hand training, that you may make an independent living for yourselves.

APPENDIX A A.

PAPERS RELATING TO TECHNICAL EDUCATION IN ENGLAND.

I. Introduction.

II. Extracts from Inaugural Address on Technical Education in English Elementary schools by M. C. J. Dawson, President National Union of Elementary Teachers, New Castle, on Tyne, March 26th, 1883.

III. "Workshop Instruction in Technical Schools," 1884.

IV. "Technical Training in Board Schools," 1884.

V. Addresses by the Lord Chancellor and the Prince of Wales at opening of The City and Guilds of London Institute, 1884.

APPENDIX A A.

PAPERS RELATING TO TECHNICAL EDUCATION IN ENGLAND.

I.

INTRODUCTION.

A paragraph in Dr. Fuller's inaugural address at Worcester, Massachusetts, in June 1883,* emphatically calls attention to the present important movement in the promulgation of Technical Education in England. He says: "In the interval of three years between my two visits, and careful studies of European schools of almost every grade, there has been a very marked progress in technical and industrial training. England has doubled its outlay for this purpose within that brief time, and no one who has not been on the ground has any adequate conception of the intense interest now taken there in this form of education."

The events of the following season, the summer of 1884, in England, would go to show that so far from exaggerating or over estimating the extent and energy of this movement in England, Dr. Fuller had understated it. The publication of the Second Report of the Royal Commission on Technical Training,—a report which contains a careful survey of what is being done in this field of Education, by the leading manufacturing countries of the Continent of Europe, and also a brief special report on "Technical Education in the United States" made for the Commission by Mr. William Mather, an iron manufacturer of Sheffield, furnishes tangible proof of the very practical interest felt in the subject.

The inauguration, in South Kensington, of the magnificent new building for Technical Training, known as "The City and Guilds of London Institute," almost simultaneously with the issue of this voluminous report, by the Royal Commissioners, strikingly indicates the extent and vitality of this movement.

Within a very recent period the Guilds of London have developed great activity in this Educational direction. They built and founded a large institution known as the "Technical College of Finsbury," (a district of London), at a cost of $175,000 to serve as a model school for artisans. This school will accommodate 700 scholars and was opened February 19th, 1883. They also established the South London Technical Art School, accommodating 100 pupils.

The Central Training School building at South Kensington, opened in 1884, and in which the educational exhibit in connexion with the Health Exposition was held, represents, however, their great work.

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* See ante, pages 730–740.

Dr. Fuller mentioned the new Polytechnic building to be opened in Berlin, in October, 1883, as the largest and finest single school building in the world, and as designed to accommodate 4000 students,—but this London Institute can accommodate 6000 students!—The late Professor Huxley, afterwards President of the Royal Society, and who presided at the distribution of prizes to the pupils of the Finsbury College, December 11th, 1883, in the course of his remarks fully confirmed Dr. Fuller's estimate of the recent rapid increase of English effort for Technical Training, for he said: "that six years ago there was no efficient technical school of art or science in the City of London" while now, in 150 centres of population in the United Kingdom, classes were connected with the City and Guilds of London Institute, and there were 3000 applications for examination.

The Lord Chancellor's address, at the formal opening of the new building of the Institute by the Prince of Wales,—which follows in this Appendix,—gives a concise account of the establishment of the new Institute and of the work done by it in fostering and extending opportunities for Technical Education: while the address of the Prince of Wales, in reply, gives ample evidence of the general interest in the subject and shows, on the part of the Prince himself, an intelligent comprehension of the situation in all its various relations.

The Report of The Royal Commission before mentioned is in five large volumes; the two first published contain about 500 pages each. The first volume will be found of great value to all who care to know about the Continental schools, and are interested in the comparisons instituted between them and the British schools, which are also described. The second volume is given to a report on Agricultural Education, and to the report on the United States, which last occupies but 84 pages.

While it is of interest to know what others have to say of us and to observe what special objects of interest an intelligent foreign observer finds, this particular report is too cursory to be of much practical value for Americans. Mr. Mather, attributes the characteristics of American Inventors and Engineers,—their originality and boldness,—to the needs of the new country and to that general intelligence of the people which is due to the excellence and universality of the public school training. The notable ingenuity of our inventors, and especially the plan adopted by Americans of constructing all machines whenever possible, of interchangeable parts, met with his most enthusiastic approval. To our higher Technological schools he gives highest praise and says the similar European schools are not better, only more numerous.

It is evident that little or no attention was given by Mr. Mather to the schools of Industrial Art, or High Art, only five or six of which are even named; so that the report is valueless so far as these artistic schools are concerned; though, on what seems very insufficient ground, he does not hesitate to declare their influence upon the industries and arts of the country, to be nil! It is, however, probable that, as Mr. Mather's time was mostly given to the inspection of manufactories, machine shops, and Technical mechanical schools, he did not see, or was not informed of, the few artistic industrial developments that *have* been made. The goldsmith's work of Tiffany & Co., the embroideries and new textile fabrics, of the "Associated Artists" in New York, the Cathedral glass of Mr. La Farge, and of Mr. Tiffany; the Cincinnati Art Potteries, The Chelsea Art Tiles,

The Terra Cotta productions, the Carvings in stone and some recent architecture, all, either the direct result of the application of art to industry, or the result of art influences and of artistic training, do show some decided advances. The more general interest taken by the community, in Art and in Artistic industries, during recent years, may be fairly attributed in part to those art educational movements in the United States which definitely began in 1870, with the calling of Walter Smith to Massachusetts, and which were stimulated and widely extended through the impression made by the surpassing beauty of the examples of the artistic industries of Asia and Europe, shown at the Centennial Exposition in Philadelphia, in 1876, and which gave to multitudes of the American people their first conception of the marvellous extent and glory of the hitherto unknown realm of Art.

There certainly remains enough to be done in all artistic directions, but it were very unjust to what has been already accomplished, if this careless dictum of Mr. Mather's report were to be accepted as, in any respect, a competent conclusion or authoritative judgment.

The conclusions, arrived at by the Royal Commissioners, as given in the first volume of their Report, are quoted in full, in the Annual Report of the U. S. Commissioner of Education for the year 1882–3.

The few papers grouped in the present Appendix, have been selected as furnishing an opportunity for comparing the similar efforts in England and in America, under somewhat similar circumstances; though, owing to the different conditions of the two countries, such comparisons can never be very accurate, and these extracts are of necessity inadequate for any very thorough study; because, in the first place, the subject of Technical Training only comes within the scope of this Report as a necessary corollary and outcome of the training in industrial drawing, on which, in a greater or less degree, all technical education must be based; and secondly, because space is wanting for an adequate showing of the existing English technical schools and experiments.

The extract from Dr. Dawson's inaugural address, as President of the English "National Union of Elementary Teachers", voices objections, not wholly unfamiliar to Americans, against forcing technical training, other than drawing, into the Elementary schools.

The two papers read before Section "B", of the International Conference on Education, and the brief introductory words of the chairman, and of Mr. Philip Magnus, who is at the head of the City and Guilds of London Institute, are of interest. The first paper, giving the account of workshop instruction in the Allan Glen's Institution, Glasgow, describes methods which seem somewhat to correspond with those of the Manual Training School attached to the Washington University, St. Louis, Mo.; while the recital of the effort to introduce technical training in a school in Sheffield, and the appended plans and estimates for school workshops, will be of interest to those whose attention has been drawn to the Dwight School experiment in Boston, and to the Free Public Manual Training School in Baltimore.

These last two papers were read on August 4th, 1884, at one of the sessions of "The International Conference on Education" held in connection with the Health Exhibition in London. The address of the Lord Chancellor to the Prince of Wales, at the opening of the City and Guilds of London Institute, has already been referred to; it contains an admirable resumé of the work of the Guilds in promoting Technical Education, and shows, incidentally, something of the extent

and object of the new movement throughout the United Kingdom. The answering address of the Prince, bears direct testimony to the general interest manifested in this new educational movement; attention is called to his remarks upon the need of training teachers, and his approval of the provision made for such training by the Institute. As has been often reiterated in this Report, there is no other way of speedily introducing a new study successfully;—the seed for the desired harvest in the pupils must be first sown in the minds of the teachers.

II.

Technical Education in English Elementary Schools.*

The following remarks upon the proposal to introduce specific technical industrial training in the English Elementary Schools are taken from the inaugural address of Mr. C. M. Dawson, President elect of The National Union of Elementary Teachers, delivered at their 14th Annual Conference, at New Castle on Tyne, March 26th, 1883. Reported in "The Schoolmaster" of March 31st, 1883.—(See page 395 of that journal.)

REMARKS BY PRESIDENT DAWSON.

"Technical education, very happily defined in a recent speech as 'the application of art and science to industry—that is, the application of truth and beauty to industry'—comes appropriately as a pendent to secondary education, of which, indeed, it may be regarded as a variety. As such, it should follow primary instruction, and not be mixed with it, except in a very elementary form, and in small proportions. As classical schools may be considered preparatory for the learned professions, and modern secondary schools for mercantile and other general pursuits, so technical schools may be looked upon as preparatory to those manufactures and occupations which need special scientific knowledge or artistic ability. The technical schools at Bradford, Leeds, Nottingham, and some other large towns must prove very serviceable in the improvement of our staple industries; and the same end is being promoted by the technological examinations under the London Guilds, and the Whitworth and other Science and Art scholarship connected with South Kensington. The application of a considerable part of the enormous revenues of the City companies to the encouragement of technical schools would be no unfit mode of using their accumulated wealth. The Royal Commission which is prosecuting its inquiry into this subject at home and abroad with such energy and completeness, will in all probability lead to important advances in technical instruction; but such suggestions as have been made by a few specialists, for the introduction of a scheme of technical instruction into elementary schools are much to be deprecated.

* Inadvertently the papers quoted in this Appendix were set in "Long Primer" type instead of in "Brevier", which last is the type in which it is intended that all quoted matter, in the volumes of this Special Report, shall be printed; so as to be readily distinguished from the original matter which is in the larger type. As the value of such a Report consists so largely in abstracts and selections, the smaller type adds greatly to the comprehensiveness, as well as conciseness of the volumes, and is, therefore, adopted.

VALUE OF ELEMENTARY TRAINING IN DRAWING.

"The curriculum is quite extensive enough already; and the teaching of drawing, which lies at the foundation of so many branches of industry, that it has been called 'the mainspring of technical education,' is about all that can fairly be attempted. And the introduction of that into the primary school is justified not so much by its practical usefulness in various industries, as by the fact that it trains the eye and hand to habits of accuracy, and develops the taste. From the commission I have mentioned we may perhaps hope for some help to improve our elementary teaching of drawing; meanwhile, it is to be regretted that the latest changes made in the regulations for encouraging the teaching of art in day school seems like to prove hindrances, rather than helps.

EXCESSIVE ATTENTION GIVEN TO SEWING.

"There is one branch of instruction, allied at least to technical, for it is in the practice of a real handicraft, of which I think we have more than enough in our girls' schools—I mean needlework. To me it seems that the devotion for about 200 hours per year for the seven or eight years of a girl's school-life to the learning of this manual occupation, must involve a waste or misuse of time, especially now when the widespread use of the sewing machine tends to lessen the need for needlework. Not to obtrude views which may be held by many to be extravagant; I will simply say that I believe no harm would be done, and I am sure most schoolmistresses would find great relief if the requirements of sewing and examination in the same were altogether dispensed with in infant schools and if they were deferred in girls' schools till the third standard were reached.

"Much of this review of the general question of national education may seem to be outside the range of matters specially interesting to teachers of elementary schools; but I hope to show further on that the whole question concerns us closely, and I regard it as part of our business to watch the signs of the times, and strive to understand the drift of events, that we may take the current when it serves, and be carried forward on its crest to the fulfilment of our reasonable hopes. I hope, too, that the discerning eye, looking abroad over the whole region of education, may observe the 'streams of tendency' as they wind their courses down the slopes of time, until they form a mighty river flowing on to broader waters, whereon may ride in peaceful security and enduring prosperity the ship of the State, attended and defended by a convoy of sister-craft—literature, science, art, law, commerce, and religion."

III.

Workshop Instruction in Technical Schools.

This paper, and the one which succeeds it, were both read, in the order here given, before Section "B" of the International Conference of Education. This Conference which opened August 4th, 1884, was held in the new Building of the City and Guilds of London Institute, in South Kensington, London.* This report of the meeting is from "The Schoolmaster"† of August 16th, 1884. Mr. Philip Magnus, who made the opening address to Section B, is the Director and Secretary of the "Institute." What he says is of interest as summing up his observations as a member of the Royal Commission on Technical Education and as indicating that Art, although hardly yet recognized by the promoters of Technical Training, who are naturally first absorbed by the Engineering and Mechanical phases of the subject;—has yet, an important function to perform, if this technical training is to promote the higher forms of industrial production.

"Opening Session of Section B.

"The proceedings of this section commenced at two o'clock, Right Hon. A. J. Mundella, M. P., Vice-President of the Council of Education, presiding.

"The Chairman, in the course of some preliminary remarks, said it gave him the greatest pleasure to respond to the invitation which had been given him to take the chair on this occasion. Mr. Magnus, who would deliver an introductory address, had, during the last three years, been a member of the Royal Commission on Technical Education, and he and his colleagues had rendered most valuable service by presenting the most complete report that had ever been furnished to Parliament on this subject. Its recommendations were exceedingly wide in their scope, involving very serious responsibility upon the Education Department, and for the consideration of Parliament. And it was because he wished to recognize, to the best of his ability, the great services which Mr. Magnus and the other Commissioners had rendered to the cause of technical instruction that he hadcome there to preside over that important section."

*The admirable inaugural address delivered by Lord Reay, on the opening of this notable assembly of educators, is given in Part I of this Report. (See Appendix "H.") The official reports of the proceedings of this Educational Conference, which was held in connection with the "International Health Exhibition," are contained in the four large volumes numbered XIII–XVI, in the series of "Health Exhibition Reports." Some additional extracts from papers read before different "Sections" of this Conference, with the discussions which followed, will be found in Part II of this Report. [See Appendices "J" and "O."]

†"The Schoolmaster. An educational Newspaper and Review, London, England." Since 1872, the authorized organ of the National Union of Elementary Teachers.

THE ADDRESS OF MR. MAGNUS.

"Mr. Philip Magnus, one of the Vice-Chairmen of the Section, then delivered an introductory address, in the course of which he made frequent allusions to the report of the Royal Commission on Technical Education, of which he was an active member, pointing out subjects which might be discussed by the Section. The Commissioners recommended that drawing should be rendered obligatory in all State-aided schools. In 1882 there were more than two millions of children who were not taught drawing, the percentage to which it was taught in private schools being very small. The necessity of scientific instruction to those engaged in manufactures or the industrial arts was a settled point of education. If workshop training were introduced into our elementary schools it should not be given before the pupil had attained the fifth Standard. The results at which the Royal Commission had arrived with respect to apprenticeshop schools were rather of a negative than a positive character. It was said there was no school like the factory or the workshop, and they had still to ascertain the trades for which these training schools could give the best instruction. Then there was the question of evening classes in which scientific instruction was given in the principles of mechanics, of geometry, and chemistry. It was a question of importance whether the system of teaching specially adapted for boys in middle-class schools was adapted for adult workmen. There was no doubt that in the selection of foremen from workmen preference would be given to men who had made themselves conversant with more than one branch of the trade in which they were engaged. It was one of the functions of the technical schools to give that wider instruction. In the department of art they were still groping their way. The design might be very beautiful, but not adapted for the material in which it was to be worked. The designer must be something more than an artist. In France Industrial art-teaching was but little attended to, but in Germany this was a very important branch of instruction. There were schools for applied art where drawing and painting were taught with reference to special industrial trades. Technical instruction in reference to art had only arrived at an early stage in this country. The question was how that knowledge could be enlarged. He was glad to see that a day was to be devoted to the consideration of the teaching of art in its industrial phases and aspects."

A vote of thanks having been accorded to Mr. Magnus for his address,

Mr. E. M. Dixon, of the Allan Glen's Institute, Glasgow, read the following paper on

WORKSHOP INSTRUCTION IN TECHNICAL SCHOOLS.

"In the present paper it is intended to summarise as briefly as possible the results of four years' experience in workshop instruction in connection with the Allan Glen's Institution, Glasgow; and, in order that this experience may be correctly judged of in relation to the experience of other technical schools, it will be necessary to state at the outset what is the aim of the institution in question.

"This institution is organized so as to supply a suitable education to boys who are intended for mercantile or manufacturing pursuits until they attain to their sixteenth or seventeenth year. The scope

of the teaching has been determined by considering the age at which lads belonging to the middle classes usually leave school to enter upon apprenticeships. Speaking for Glasgow, we may say that this age rarely exceeds sixteen or seventeen years; and that, in point of fact, it falls in the great majority of cases considerably below either of these limits. This statement, it may be remarked, is true, not merely in families where the expense of educating lads to their sixteenth year is somewhat beyond their means, but it is also true in very many cases where the expense of education is not a matter of much consideration, but either where the education that a school can supply to a lad of sixteen is believed to be less valuable than the practical education he acquires at that age in the office or in the workshop, or where the parent's authority is insufficient to keep the boy at school.

GENERAL STUDIES PRECEDE THE TECHNICAL.

"The scope of the instruction being determined by the age at which pupils leave school to begin apprenticeships, the subjects of that instruction have in like manner been fixed, by considering that the object really is to prepare lads for learning thoroughly trades that have a mechanical or chemical basis, and this, too, in view of the fact that, as apprenticeships generally exist at present, the actual workshop must be regarded as a very defective teaching institution. It had also to be kept in mind that technical instruction must be preceded by, and indeed as far as possible accompanied by, a thorough course of education in English and other subjects that belong to a liberal and general education.

"Guided by these considerations, it was evident that, in regard to what may be called the scientific and technical subjects, a school such as the one now in question, must lay much stress upon mathematics, physics, chemistry, and drawing, and treat these subjects, at least in the earlier stages, as part of the curriculum of study of every pupil, whether intended for industries of a mechanical or of a chemical nature. As it further seemed desirable to provide means for pupils to acquire something in the shape of really professional instruction in each of these directions, it became necessary to introduce specialization of technical studies in the last year's course, and to give, in the direction of engineering on the one hand, and of practical chemistry on the other, instruction of a character as real and practical as possible. It need scarcely be added that a chemical laboratory and a school workshop are necessarily two of the class-rooms of an institution that was to be organized on these lines, and we have now to estimate, as accurately as possible, the results that have come from the teaching in one of these during the last four years—viz., the workshop.

HOW DRAWING IS TAUGHT IN THIS SCHOOL.

"Instruction in drawing naturally commences with free-hand drawing, and that subject is regularly taught during five successive years to every pupil who goes through the full curriculum of the school. Such a pupil has had three years' instruction in free-hand drawing by the time he commences the study of mathematics—that is, on an average, when he is about thirteen years of age; and during the next two years he receives instruction, not only in free-hand drawing

and mathematics, but also in drawing with instruments, in the elements of physics and of chemistry, and in the principles of theoretical mechanics. It is at the end of this time that the pupil is introduced to mechanical drawing and to a course of practical exercises in the workshop, and these subjects, with others that need not be specified at present, occupy the pupil for the two remaining years of his course of study. It should be added, however, that during these last two years the pupil also continues his study of practical solid geometry, in order that he may attain to a thorough grasp of that subject, as it forms, in fact, the foundation of all real knowledge of technical drawing under its various forms. In this way, the pupil who passes through the full curriculum has instruction for five years in free-hand drawing, for four years in practical, plane, and solid geometry, and for two years in machine drawing.

PRACTICAL DRAWING IN THE WORKSHOP.

"In the workshop he also has instruction for two years in making models, patterns, or other articles in wood or metal from working drawings, and according to measurement. His exercises in machine drawing are also carefully graduated during his two years' course, so as to keep clearly before him at all times the relation of the object to the drawing or drawings of it, that he may be making. A pupil is never allowed to make a mere copy of a drawing, but he may have to make a proper scale drawing from a rough dimensioned sketch, or produce a drawing, or set of drawings, of a machine or a model, from measurements taken from it by himself, and in the last year of his course he may have to do exercises involving more or less original designing.

"The exercises of the workshop operate, therefore, in training the pupil to see with his mind's eye the object in the drawing, that is to say, he there learns in the most real way the interpretation of mechanical drawings; and, when with skill in that direction there is conjoined on the other hand ability to draw, the qualifications of the mechanical draughtsman are supplied.

METHOD OF INSTRUCTION IN THE MECHANICAL COURSE.

"Finally, it may be well to state how the instruction in engineering, generally, is given in the Allan Glen's Institution. As principal teacher, we have a gentleman who held one of Sir Joseph Whitworth's scholarships for three years, and to whom is entrusted all the theoretical instruction, and the superintendence of the operations carried on in the workshop. In the workshop, again, an excellent workman, who is also able to prepare lecture diagrams, and otherwise occupy his time in school work when not engaged with pupils, is present during the school hours of every day. As pupils require a large amount of personal attention, it has been found to be impracticable, with one teacher, to send into the workshop more than about fifteen pupils at the same time, and hence classes exceeding that number have to be taught in relays. This, however, does not in actual operation cause any serious inconvenience. The larger tools, such as saws, planes, &c., belong to the institution, and each pupil has to provide himself with a box of small tools that cost him about £1. The material at first employed by the pupils is wood, and so long as they are unable to work fairly well to measure-

ment, the articles made by them are simple ones of their own selection, and become their own property upon payment of the material consumed. On the other hand, after a pupil has advanced to the point of being able to make a wooden model to scale, he begins to work for the institution, and regularly employs working drawings. He proceeds afterwards tc work in metal, when, in the opinion of the principal teacher, he is able to take that step with advantage. As to the spirit with which boys go into their exercises in the workshop, I need merely say, it is what any person might anticipate who remembers the pleasure he had himself when young in working with tools of any kind; and as to the quality of the work that lads can be got to do under the circumstances I have endeavored in this short paper to explain, I will leave the exhibit of models from the Allan Glen Institution to speak."

"The Chairman remarked that they had heard a very excellent paper from an earnest practical Scotchman, in which he had given most interesting information of the practical working of one of the best institutions of his country. He knew instances of boys, educated in the Allan Glen Institute, having taken positions which he should never have thought boys of their age could so rapidly have attained. It was for such puposes that technical instruction was needed, and in his own fashion Mr. Dixon had worked out an excellent technical system."

IV.

Technical Teaching in Board Schools.

Mr. J. F. Moss, Clerk of the Sheffield Board School, next contributed a paper on "Technical Teaching in Board Schools."

"The experiment has been tried, with some degree of success, of teaching boys at selected schools to make up some simple articles of furniture, and a great amount of interest has been shown by the pupils.

PEDAGOGICAL METHODS ESSENTIAL.

"But to be of fullest value the school-workshop should have a much wider aim than that of mere amusement, or even the teaching of young people to do a few useful things. It should supply a connecting link—practical in its bearing, and thoroughly educational in its character—between theoretical knowledge, as heretofore too exclusively relied upon, and the industrial pursuits in which such knowledge may be applied. It should be an integral part of the educational system, adapted to the requirements of industrial communities. It should become a means of illustrating scientific principles and of applying in practice theories which, of themselves, too often appear to the pupil as useless dry bones. The training of the hand and eye should be immediately associated with the development of mental faculties. The practice in the workshops, then, should have a distinct and definite relation to the work of the school itself; one should work naturally into and help the other.

"An experiment in this direction with which I have been associated in Sheffield, has been carried out in connection with the Central Higher Board School. Here the ordinary work begins with the sixth standard—it did up to this year begin with the fifth standard—and some 600 pupils selected by examination from other public elementary schools have the opportunity given them of taking up drawing in its various branches, including geometrical drawing and machine drawing and construction, besides mathematics, mechanics, chemistry, magnetism, and electricity, and other subjects, which, for reasons that need not here be dwelt upon, it would be impossible to teach with advantage in ordinary public elementary schools without either involving excessive expenditure or the neglect of other essential work.

AN EXPERIMENT IN MANUAL TRAINING.

"What has been so far attempted may be briefly stated. Some ordinary workshop benches have been fitted with simple appliances for working in wood and iron. Various local firms have gratuitously supplied excellent sets of tools, and the upper boys of the school are

encouraged to come before the ordinary school hours and use them under the direction of the science master and a skilled mechanic. Only a small number of pupils can be accommodated at one time, but they gladly do the work without interfering with their regular course of study—in fact, admission to the workshop is accounted a high privilege—and there is no doubt that in many respects the privileged ones gain substantial advantages. Thus from geometrical drawing the pupils naturally turn to the shaping of correct geometrical forms in wood and iron, and it may be safely assumed that their workshop practice has been of immense value in increasing their appreciation of the subject in all its bearings. The thing assumes a reality which lines on paper and dry formulæ could not give. Mechanical drawing, too, is invested with greatly increased interest when in the workshop its language can be practically interpreted and exemplified. In this department of work, Mr. Ripper, to whom I am indebted for much practical information upon the subject, has been singularly successful with boys even of twelve and thirteen years of age, but this success is undoubtedly attributable in a great measure to his own practical knowledge as distinct from the power alone of teaching drawing. Mere cleverness in drawing is of secondary importance as compared with a correct understanding of the principles of construction and the why and the wherefore of the parts delineated. Therefore, before pencil is put to paper, the pupil is required to clearly understand the uses and application of whatever portion of machinery is to be drawn. But how greatly must the value of this kind of instruction be enhanced when the pupil can afterwards proceed to the actual construction of working models.

"Those who are thus trained, will start in the world with very distinct advantages; with grander conceptions of the dignity of labour; fuller appreciation of the duties of artisanship, and brighter prospects of useful careers than could possibly be theirs without such aid. One good moral effect has already become apparent: boys begin to account it more honourable to seek useful positions in the workshop than to hanker after clerkships, or what have been called more 'genteel employments.' And there is no doubt they may have better chances of promotion, for among such will probably be found the foreman of the future whose scientific knowledge will displace the old rule of thumb, increasing the productiveness of labour, and inducing a higher standard of excellence which must directly tend to the national welfare."

SUGGESTIONS FOR A SCHOOL WORKSHOP.

Appendix.—As to the Equipment and Cost of a Small School Workshop.—[It should be noted that Mr. Ripper's scheme, though capable of general adaptation, may to some extent be considered as specially suitable for districts in which iron and steel industries predominate, and that for other localities greater prominence might be given to somewhat different lines of work.]

(1) *Wood-work shop,* to accommodate about 12 boys, fitted with benches and ordinary wood working tools, to enable them to make such articles as the following:—Samples of various kinds of wood-joints, small tool-chest, barrow, writing desk, model door, cupboard, model staircase, model roof trusses; also, if one or more wood-turning lathes could be furnished, many more interesting exercises might

be attempted, such as tables with turned legs, book-shelves with turned supports, ladder, balusters, clothes-horse, towel rack, fancy articles, etc.

(2) *Iron-work room* to accommodate twelve boys, fitted with benches, twelve engineers' vices, hammers, chisels, and files, grindstone, two or three smiths' forges and anvils, hand drilling-machine, and, if possible, a small iron turning-lathe. A useful set of exercises might include: wrought-iron fire-screens, wrought-iron model gates, model bridges, model roof-trusses, model crane, the filing up of plane surfaces, and of simple geometrical forms with accuracy.

(3) *Clay-modelling room*, also to accommodate about twelve boys, and fitted with benches, modelling tools, and plaster casts.

By the above arrangement a class of thirty-six boys spending, say, four or six months in each department, and working from an hour to an hour and a-half before or after ordinary school hours each day, or for, say, three or four hours on Saturdays, would obtain a highly useful practical training.

(4) In addition to the above three rooms, another room to be set apart as an experimental mechanic's laboratory, and as a store-room in which to place the best specimens of workmanship from the workshops, models for machine drawing, &c.

The mechanical apparatus required is similar to that devised by the late Professor Willis of Cambridge, such as is now made by Messrs. Rigg, of 11 Queen Victoria Street. The object of this apparatus is to enable a class of boys, under the direction of a teacher, to go through a series of simple quantitative experiments in the principles of mechanics, the boys themselves handling the actual apparatus.

A list of suitable experiments may be found in Professor Ball's book on Experimental Mechanics; also in Professor Perry's Practical Mechanics.

[By the kindness of Messrs. Rigg some sample experiments have been fitted up for inspection.]

The boys to be required to adapt, fit and bolt together, the various parts from a hand sketch of the arrangement in their own note books, and which has been previously explained in class. They are also to note down carefully the result of their experiments.

Approximate cost of tools, &c., required for the fitting up of an efficient school workshop to accommodate 24 boys working at one time, 12 at iron and 12 at wood :—

	£	s.	d.
Wood tools, 12 sets at 15s. 6d.	9	6	0
Iron tools, 12 sets at 27s. (including vice)	16	4	0
A good collection of wood tools for general use for doing advanced work	30	0	0
Ditto iron tools	30	0	0
Bench accommodation 24 (at 30s. per head)	36	0	0
	121	10	0

The above does not include wood or iron-turning lathes, which would be most successfully used when driven by a steam or gas engine.

The tools may be used by any number of classes of 24 lads.

The cost of furnishing the clay modelling-room would be merely nominal."

V.

Addresses by the Lord Chancellor and the Prince of Wales at opening of the City and Guilds of London Institute.

The address of the Lord Chancellor to the Prince of Wales, which follows, was made on the occasion of the formal opening by the Prince of Wales, in his capacity as "President of the City and Guilds of London Institute for the Advancement of Technical Education," of The New Central Institution Buildings, in Exhibition Row, South Kensington.

A distinguished company of gentlemen, of City and Guild Officials, etc., were present.

The Lord Chancellor said:—"May it please your Royal Highness,—I have to thank your Royal Highness, on behalf of the Council and of the Governors of the City and Guilds of London Institute, for having graciously consented to open this Central Institution, thereby showing your continued interest in the success of the great educational work which the Corporation and the principal Guilds of London have combined to promote.

"It is now very nearly three years since your Royal Highness, in July, 1881, accompanied on that occasion by her Royal Highness the Princess of Wales, set the first column on which this building rests, and we are glad to be able to state that, under the able superintendence of Mr. Alfred Waterhouse, the architect, the work has been satisfactorily executed within the time originally intended. Nothing is now wanting for its completion but some of the internal fittings, furniture, and apparatus; towards the provision of which the City and many of the Livery Companies of London, in response to the appeal of your Royal Highness, have already contributed nearly £17,000. It is estimated that the building, when fully equipped, will have cost nearly £100,000 and the Council confidently trust that the balance still needed for its completion will be supplied by the liberality of the City Guilds, on which they have hitherto, so hopefully, and so exclusively relied. (Cheers.) Pending the completion of the fittings, your Royal Highness, as President of the International Health Exhibition, will be gratified to learn that the Council of this Institute have been able to lend a portion of this building for the exhibition therein of educational and school appliances, to the Executive Council of the Health Exhibition, who, in compliance with our request, have courteously postponed the opening of that interesting section of their exhibition until to-day.

"During the last three years the progress of the work initiated by the City Guilds has been most gratifying. The Finsbury Technical College, the foundation stone of which was laid in May, 1881, by the late Duke of Albany, whose loss we, in common with all classes of Her Majesty's subjects, deplore as a national calamity, was opened

in February, 1883. It is now in full working order, affording a sound and complete technical education to youths from middle-class schools who are preparing to enter industrial careers at a comparatively early age, as well as to large numbers of artisans engaged in various trades.

"At South London our Applied Art School is filled with students who are being trained as wood engravers, and as designers for different branches of industry.

"The affiliated classes in the provinces, in connection with our technological examinations, have increased in number far more rapidly than could have been anticipated, and have developed in many cases into excellent technical schools.

"In 1881, when I had the pleasure of addressing your Royal Highness on the ground on which we are now standing, I stated that the number of candidates for the technological examinations was 1,563, as compared with 816 in the previous year, and I am now able to state that the number recently examined was 3,628, as compared with 2,322 in 1883. (Cheers.) A great impulse was undoubtedly afforded to the establishment of technical schools in this country by the appointment in 1881, of a Royal Commission, presided over by Mr. Bernhard Samuelson, M. P., to inquire into the facilities for technical instruction enjoyed by the industrial classes abroad, and to compare them with the opportunities enjoyed by similar classes at home.

"After a laborious investigation, occupying nearly three years, in the course of which they visited all the principal technical schools in Central Europe and in the United Kingdom, the Commissioners presented to Her Majesty a report, in which they were able to show that, owing greatly to the action of the Science and Art Department and of the City and Guilds of London Institute, the opportunities afforded to workmen and to foremen in this country to obtain, by means of evening classes, sound technical instruction, compared favorably with those enjoyed by the same classes abroad; and it is gratifying to learn from them that no organization like that of the Science and Art Department, or of the City and Guilds of London Institute, exists in any Continental country, and that the absence of any such organizations has been lamented by many competent persons with whom they came in contact.

NEED FOR INSTITUTIONS GIVING HIGHER TECHNICAL INSTRUCTION.

"It is, however, in the appreciation of, and in the facilities for, higher technical instruction that we in this country are most deficient, and it is to supply that want that this central institution has been established. In their report on technical instruction, the Commissioners state that 'no portion of the national expenditure on education is of greater importance than that employed in the scientific culture of the leaders of industry,' and that 'the Englishman has yet to learn that an extended and systematic education, up to and including the methods of original research, is now a necessary preliminary to the fullest development of industry.' (Cheers.) It is hoped that the educational work to be carried on in this institution will have the effect of raising the standard of technical instruction throughout the entire kingdom. This college has been established to meet a two-fold want. It is intended to give that higher instruction of which the leaders of our industries stand so much in

need; and also, and principally, to train teachers for the several technical schools and classes which, owing greatly to the encouragement afforded by this institute, now constitute an important feature in our educational system.

"The institution which your Royal Highness is pleased this day to open is indeed one of national importance, serving the double purpose of a Technical University and of a Normal School.

"In the several laboratories with which this college is provided, and which will be directed by eminent Professors already elected, new and increased facilities will be afforded for the prosecution of original research, having for its object the more thorough training of the students, and the elucidation of the theory of industrial processes; and, with the view of making the teaching of the college bear directly upon the studies of those who may be already engaged, or about to engage, in manufacturing industry, special courses of instruction will be given in the technology of various trades. By means of scholarships, such as those established by the Clothworkers' Company (cheers), it is hoped that this institution may receive within its walls students, some of whom may have obtained their early training in one or other of the excellent public elementary schools which now, happily, abound in this country; and that new careers will be thus opened to the children of our artisan classes, which will provide them with honorable and remunerative employment, and will at the same time enable them to help in advancing the commercial prosperity of the nation.

A COMPREHENSIVE SCHEME OF TECHNICAL INSTRUCTION.

"In this way, and by the gratuitous instruction which it is proposed here to give to teachers of technical classes, the influence of this college will be felt far beyond the limits of the metropolis; and all classes of the community will share in the advantages which it will confer, while the country at large will be benefited by the knowledge here originating, and by the skill here acquired. Within these walls will be gathered together some of the chosen intellects from schools and colleges of every grade, competing with one another, without distinction of class or creed, in the endeavour to apply the results of scientific investigation to the discovery of new processes of manufacture, and of new methods for increasing and improving the products of human labour.

"The ceremony of to-day, honored as it is by the presence of your Royal Highness (cheers), marks the completion of the scheme for the advancement of technical education, as organized by the City and Guilds of London. It is a scheme that embraces the education of workers of every class, of the apprentice, the journeyman, the fireman, the manager, and the master, as well as those who are to become their teachers. As years roll by, and when the connexion between the technical education of the people and the commercial prosperity of the country becomes as well understood and appreciated here as it is abroad, the year 1880, in which the City and Guilds of London Institute was incorporated; and the year 1884, in which this central institution was opened, will stand out as epochs in what we hope may be an unbroken record of industrial progress; and we sincerely trust that the remembrance of this day's proceedings may ever furnish to your Royal Highness a pleasing and satisfactory thought, enabling you to associate the endeavours of your illustrious father (cheers),

dating back more than 30 years, to improve the arts and manufactures of the country, with the work of this Technical Institute, over which your Royal Highness so graciously presides. (Cheers)."

RESPONSE BY THE PRINCE OF WALES.

"At the conclusion of the Lord Chancellor's address the Prince responded as follows:

"The Prince of Wales in reply, said,—My Lord Chancellor, my Lords, and Gentlemen,—I have listened with attention to your address, and I assure you it gives me great pleasure to be able to preside at the opening of this important institution, the first pillar of which, in company with her Royal Highness the Princess of Wales, I set nearly three years since. I thank you for your very feeling reference to the severe loss which the Queen, and each member of Her Majesty's family has sustained by the untimely death of my late brother. His interest in every movement calculated to humanize and to elevate the people of this country will, I am quite sure, cause his loss to be felt far beyond the circle of his immediate friends. I have been gratified that the City and the Livery Companies of London have so generously responded to the letter which, as president of the Institute, I addressed some few months since to the Lord Mayor and to the Worshipful Masters of the Livery Companies of London. This Institute, which owes its origin to the liberality of the City and of the Guilds of London, is an illustration of the excellent work that may be done by united action, which could not possibly be accomplished by individual efforts. Conformably with the traditions of these ancient Guilds, there is, perhaps, no purpose to which they could more appropriately devote their surplus funds, and none which would be of more practical advantage to the country at large than the promotion of technical education. (Cheers.)

MODERN NEEDS FOR SCIENTIFIC EDUCATION.

"The altered conditions of apprenticeship, and the almost general substitution of machine for hand labor have made the teaching of science, in its application to productive industry, a necessary part of the training of all classes of persons engaged in manufacturing pursuits.

"There never was a time, perhaps, when the importance of technical education was more generally recognized than now, and I am gratified to learn from the report of the Royal Commissioners appointed to inquire into the subject to which your lordship has referred, that, although we are still behind many of our foreign neighbors in the provision of technical schools of different grades, the encouragement afforded by the State to the teaching of science and of art, supplemented as it now is by the institute's assistance to the teaching of technology, has placed within reach of our artisan population facilities for technical instruction, which have already influenced, and which promise to influence still more in the future, the progress of our manufacturing industry. (Cheers.) As president of this Institute, I have noticed with much satisfaction the rapid development of the work which the council have initiated, and which they so successfully control.

A TRIBUTE TO MR. PHILIP MAGNUS.

"I am anxious to take this opportunity of expressing in public what is already known to you, my Lord Chancellor, and to the members of the Council, the obligations which we are all under to Mr. Philip Magnus, our able director and secretary, for his unwearied exertions in having so successfully accomplished the organization of the practical work of the institution. (Cheers.) I have no doubt that the opportunities for advanced instruction, which will be afforded in the well-arranged laboratories and workshops of this building, will enable the managers and superintendents of our manufacturing works to obtain more readily than hitherto that higher technical instruction which is so essential to the development of our trade and commerce. But it is especially as a training college for teachers that this institution will occupy an important place in the educational establishments of this country.

"The demand for technical instruction has increased so rapidly during the last few years that the supply of teachers has not kept pace with it, and I have noticed with satisfaction that in the scheme for the organization of this school due prominence is given to the provision of gratuitous courses of instruction for technical teachers from all parts of the kingdom. I shall be glad to see other corporations and individuals follow the example of the Cloth Workers' Company (cheers), by establishing scholarships which shall serve to connect the elementary schools of this country with this institution.

"Hitherto, all schools have led up to the Universities, and literary training has been encouraged to the disadvantage of scientific instruction. (Cheers.) Manufacturing industry has, consequently, not been able to attract to its pursuits its fair proportion of the best intellect of the country. The foundation of scholarships in connection with this institution will enable selected pupils from elementary schools to enter schools of a higher grade, and to complete their education within these walls. As president of the International Health Exhibition, I am glad that the Council of this Institute have been able to place at the disposal of the Council of the Health Exhibition a portion of this building for the exhibition of apparatus and appliances used in technical and other schools. I have no doubt that we shall find in that exhibition, which I hope to be able presently to visit, much that is generally instructive, and that the foreign sections will contain exhibits which will prove of great interest to the educational authorities of this country. To the Corporation and to the Livery Companies of London, the Council of the International Health Exhibition are indebted for much valuable assistance, and I thank them for it.

"It now only remains for me to declare the Central Institution of the City and Guilds of London Institute to be open, and to express the warmest hope that the important educational work to be carried on in this great national school of technical science and art will help to promote the development of our leading industries, and that the City and Guilds of London, which have so liberally subscribed funds for the erection and equipment of this institution will maintain it with efficiency, and will at the same time continue their support to all other parts of the institute's operations. (Cheers.)

"Other brief addresses were made, First by Lord Carlingford, President of the Committee of Council on Education; who prepared

the resolution "That thanks are due to the City and to the Livery Companies of London for their liberal and successful efforts in the cause of technical education." This resolution was seconded by the Right Honorable A. J. Mundella, M. P., Vice President of the Council. The Lord Mayor of London, as officially representing the City & Guilds of London, 'briefly tendered their thanks to the Prince of Wales for the terms in which his Royal Highness had spoken in appreciation of the efforts they had made to establish and promote the efficiency of this institution.' (Cheers.)"—From the London Times of June 26th, 1884.

APPENDIX B B.

PAPERS RELATING TO TECHNICAL ART TRAINING IN ENGLAND.

I. Introduction.

II. Recognition of the need of Technical Art Training, as shown by article in The London Times on Lord Hartington's address on that theme.

III. Article from The Westminister Review showing relation of Technical Education to Foreign Trade Competition.

IV. A Statement of the Purpose of The National Association for the Promotion of Technical Education in Great Britain.

V. Address by Professor Huxley, at Manchester, at a meeting held in the Town Hall, November 29th, 1887.

APPENDIX B B.

PAPERS RELATING TO TECHNICAL ART TRAINING IN ENGLAND.

I.

INTRODUCTION.

The growing necessity of some form of technical training for the great body of workers, which has long been accepted and acted on by Belgium, France, Germany and Switzerland, is beginning to be recognized in Great Britain, as was shown by the creation of the Royal Commission on Technical Instruction whose investigations, abroad and at home, occupied some four years and whose admirable and comprehensive Report, made in five volumes in 1884, attracted so much attention. The importance of this subject of industrial and technical training in the opinion of the English people may be inferred from the attention given to it by the leading statesmen of the country, and the interest shown by the Royal family, who follow in these matters the example of the late Prince Consort.

On the occasion of the fourth annual distribution of prizes, etc., by the Polytechnic Young Men's Christian Institute, Regents Street, London, the Marquis of Hartington presided and, after the prizes had been distributed, delivered a notable address; of sufficient importance in the judgment of the London Times to be considered at length the next day, March 17th, 1887, in a leading article.

The Polytechnic Institute appears to resemble, in purpose and management, the well known Cooper Union of New York. It was opened in 1883, and was attended by 3,200 students in the various Science, Art, Technical and general classes. The attendance for the year ending June 30th, 1886, was 6,875.

In the course of his remarks Lord Hartington said: "What is still deficient is the adequate technical and trade instruction of the labourers themselves, and that is the great object which this institution is intended to supply." As thus defined, this "Institute" may be classed with the Maryland Institute of Baltimore, the Franklin of Philadelphia, and like institutions; accounts of which are included in Part III, of this Report.

The length of the address precludes its insertion here; but, as the substance of it is indicated in the Times leader, that is quoted; because the ideas advanced are as applicable and as important for Americans, as for Englishmen.

This is followed by several extracts from a striking article on "Technical Education and Foreign Competition" which appeared in the May and September numbers of The Westminister Review, for 1887. Similar topics are treated in this article and it is well for Americans, who are as yet so far behind the English in their

provisions for the general, definite technical and industrial training of their people, to see for themselves the value and importance put upon these instrumentalities by older nations. Whatever strength the arguments may have for Englishmen, they should have far greater force for Americans; since our lack of opportunities for any adequate technical training in artistic industries, is far greater than theirs.

The address by the late Professor Huxley, F. R. S., delivered in the Town Hall of Manchester, is, in common with all his utterances, worthy of serious consideration; extracts which relate more directly to the topics here discussed are given; this is preceded by a formal statement of the Purpose of The National Association for the promotion of Technical Education. These two papers, which fitly conclude this Appendix, give ample proof of the grave importance in which the topics discussed in this Report, are held by the thoughtful leaders of Public Opinion in the British Isles. Are they not equally worthy the attention of American Legislators and Educators?

II.

Editorial Comment On The Address By Lord Hartington, On The Need Of Technical Art Training.*

Lord Hartington made a striking speech last night to the Polytechnic Young Men's Christian Institute—a speech more robust than those generally heard at similar institutions. In presence of such an audience a text was perhaps needed, and he took as his text some remarks by Professor Huxley, who lately pointed out the instructive likeness between warfare and industry. The latter "does not break heads and it does not shed blood, but it starves the man who succeeds in the war of competition, and the nation which succeeds in the war of competition beats the other by starvation." On that impressive text Lord Hartington made a no less striking commentary. He pointed out how much our industrial position depended on the efficiency of individual workers—how that counted for more than beds of coal or deposits of iron—and he drew a picture of the consequences of industrial decadence to a country such as ours. How is that calamity to be averted? By the same means he answers, by which you may hope to prevent disasters in warfare. It is impossible in actual hostilities to extemporize effective armaments; "the possession of scientific knowledge and perfect appliances" is essential in warfare, and the same holds good of industry. In both the prize goes to those who are best prepared to run the race. The comparison is impressive; the consequences are far-reaching. If we are well advised—and Lord Hartington has no misgivings on the subject—in spending freely to protect ourselves against aggression, it is equally our duty to be not niggardly in providing industrial education and diffusing scientific knowledge. It is the condition of industrial supremacy, and it is not an unattainable condition. That supremacy "we still maintain, and if we only make adequate exertions I doubt not that we can still maintain it."

THE LEGITIMATE PROVINCE OF EDUCATION.

No education can produce genius. Inventive skill comes, or fails to come, from causes too subtle to be reached by systems of tuition. A Watt or even an Edison is born, not made. But the knowledge of drawing, mechanics, mathematics, chemistry, and the other sciences or arts which aid the artisan in his daily work may be imparted, and on the spread of such knowledge may depend the continuance of industrial supremacy. Great commanders cannot be called into being; but in the main it depends on the rank and file of the army of industry whether its battles are lost or won.

How is this work to be accomplished? In answer to this question Lord Hartington let fall one or two remarks which, though not offering a complete solution, are, if we mistake not, likely to be fruitful in consequences. They cannot fail to materially influence opinion. The State, he is satisfied, cannot do all or much; and he is struck with the inability of purely voluntary efforts to meet the demand. He finds the necessary assistance, if anywhere, in our municipal institutions. "I hope

* The Times, London, England, March 17th, 1887.

the time is not far distant when our town councils or local governing boards will establish in every considerable centre industrial and technical schools, suitable to the wants of the district, and supported out of local funds." The institutions which now imperfectly do the work of diffusing technical instructions "are playing the same part in relation to technical and industrial education that was played by the voluntary schools in relation to elementary education."

A NATIONAL SYSTEM OF TECHNICAL EDUCATION FORESHADOWED.

This points to a national system of technical education; it is the largest and clearest conception of the subject which any public man of importance has yet put forth. What would be the details, or even all the main lines, of such a scheme the speaker did not say; it was not his business to deal with such matters. Many difficulties and objections suggest themselves, and not a few Englishmen will be reluctant to believe that the rough-and-ready methods which have satisfied us in the past will not suffice for the future. But the more Lord Hartington's main idea is considered, the more truth will be found in it; the clearer will it become that industrial knowledge is needed as it never was before, and that it is not to be dispensed with by existing appliances. Sir Henry Roscoe said last night that English competition at this moment was not seriously feared abroad; "what foreigners feared was that some day the nation would awaken to the necessity of educating its workers as they were educated abroad, for then they felt that they would not be able to compete at all with English industries." From all persons competent to express an opinion comes the same story; our rivals are making headway because we have not sought to make our workmen efficient, and because we are trusting too much to old methods. It is too rare to hear a public man in these days utter sound economical doctrines if they happen to be unpalatable. They are apt to speak as if their audiences would tolerate such teaching only when sweetened and diluted in a fluid sentiment. The question treated of last night has its dark sides, and Lord Hartington did not shirk them or say that all would be well if only a few simple expedients were resorted to.

THE INDUSTRIAL SITUATION IN RELATION TO EDUCATION.

His remarks reveal a clear perception of the truth that much so-called education is of little use to men compelled to struggle for their livelihood; that strife and warfare lie at the bottom of an industrial society; that this struggle and warfare grow keener where the sound of the trumpet is never heard; and that the race between inventors of steel plates, repeating rifles, and machine guns has its counterpart in every trade. There is no demand for a Polytechnic Young Man with a smattering of everything. We are no believers in the supreme efficacy of freehand drawing; everything else in the curriculum ought not to be sacrificed to this or any other accomplishment. It would be a pity if young men forsook theoretical works on chemistry to dabble too early in dyes, or remained for the rest of their lives ignorant of mathematics by reason of their assiduity at the lathe. It would in the end defeat its purpose to foster a premature acquaintance with the "bread and butter" arts and sciences to the neglect of studies which enlarge the mental horizon and discipline the mind. But such practical knowledge must somehow be got, and it is not now got by a sufficient number. The nation that has most efficient mechanical engineers will have the best engine shops and, presumably, will in the long run do most business. The country which has the largest number of persons conversant with the wants of those who consume coarse cotton goods will get most of that trade. In industry or in warfare the victory will be with those who are best prepared—which is not, Lord Hartington tells us, our present position, and which may be still less true of us than it is if no means are taken to correct palpable deficiencies.

III.

The following are the extracts from "The Westminster Review," referred to in the Introduction to this Appendix.

Technical Education And Foreign Competition.

There is undoubtedly a great change coming over public opinion with regard to the bearing of education upon the practical work of life. It has at last become recognized that a school-boy may be materially helped in his choice or pursuit of calling by his training at school, and that it is the duty of the State no less than of the individual to see that each child shall be taught to be useful and effective in the world. It is also admitted that the discipline of the mind may be promoted by the theoretical study of the principles of industrial and commercial life, as well as by classical literature. And there are many thorough-going educationists who believe in the words of Mr. Ruskin, that "what it is most honourable to know, it is also most profitable to learn; and that the science which it is the highest power to possess, it is also the best exercise to acquire." Yet these principles, far from being recognized, were mainly ignored in the public schools of the past. * * * As for practical knowledge, the study of art and science in their relation to the possible career of the student, the training of the hand in any manual employment, the knowledge of the great material resources of the country and the mechanical aids by which they were to be utilized, the principles of agriculture, of commerce and of trade—these studies were scarcely included in the educational curriculum of the wealthy, or, if they found some scanty place among the extras, it is said by qualified witnesses that as a branch of education they were usually ignored and despised. * * * Thus we had the spectacle of the most practical people in the world receiving the most unpractical education, and yet prospering in spite of their deficiencies.

THE GREAT INVENTORS OF THE EIGHTEENTH CENTURY.

The great industrial development which began in this country about a hundred years ago derived but little if any aid from the ancient seats of learning. The mechanical inventors of the end of the last century, to whom the civilized world owes unspeakable obligations, were in nearly every instance poor, obscure, and uncultured. Many of them were, as was recorded of them by Macaulay "ignorant of letters, without art, without eloquence; yet who had the wisdom to devise and the courage to perform that which they lacked language to explain. Such men have worked the deliverance of nations and their own greatness. Their hearts are their books; events are their tutors; great actions are their eloquence." In every industrial centre the traditions of these pioneers, and of their successors who profited by their inventions and discoveries, still linger among the people.

FORMER LACK OF EDUCATIONAL OPPORTUNITIES.

The wealthy manufacturers, the engineers and eminent machine makers of the last generation were remarkable for perseverance, thrift, indomitable energy, and in some instances for natural talent of a high order; but in the main they enjoyed no educational facilities. Except for such tuition in elementary science as a few were able to obtain in the evening classes of Mechanics' Institutions, which were founded in the early part of the century, the whole mass of employers and employed were "ignorant of letters" and "without art" or other scholastic culture. There were no public institutions in the country offering a scholastic training in science and art, or in the methods of commerce and modern languages, &c., appropriate for manufacturers, engineers, and merchants; and the industrial capitalists had no idea as to the means of obtaining or the advantages of such training. None doubted the appropriateness of a college education for professional men, for doctors,

lawyers, or divines; but such an education was considered incompatible with an industrial career. Besides, admission to the great public schools was all but impossible to the sons of commercial men, and where the coveted distinction was achieved, and a young man here or there passed through the public schools, and finished his educational career at the University, he returned to his father's factory or warehouse in many instances ignorant of the most elementary principles of trade, looking down upon the whole business, and despising the source from which he had sprung. I remember a few years ago conversing with one of the most distinguished of the Manchester school of statesmen on this question. I remarked that in one of the most prosperous of the manufacturing towns of the North of England only one manufacturer had given his son a University education. "Ah," rejoined the statesman, "and probably he was spoiled by it."

THE OLD EDUCATION NOT ADAPTED TO THE NEW CONDITIONS.

In judging by results from the standard of commercial success—unfortunately the usual standard in this country—the self taught men of the old school were able to show that practical experience in the actual work of life put into the shade the teaching of the professors, and thus they were sceptical as to the value of any training that had not been acquired in the workshop or factory.

The roughest survey of the industrial growth of England will indicate how natural has been this feeling among those who have been the main contributors to the nation's marvellous prosperity. In their struggles they received little help or sympathy from the learned, titled, and propertied classes of the land, and thus they considered that learning, as represented by its supposed possessors, was of little or no account in stimulating the great industrial movement in which they were engaged. It has only been through the bitter suffering of recent years that the commercial classes have discovered their great blunder in giving so little attention to their own theoretical training and that of their men. On the other hand, the commercial and agricultural depression has compelled all classes, and none more than the learned, the titled, and the propertied, to understand their deficiencies in practical science, and to acknowledge that England's manufacturing industry is England's fountain of life, and that upon the equipment, the physical, intellectual, and moral strength of English men and women engaged in manufactures and commerce, will depend the prosperity, nay, the existence, of the empire in the future.

THE NEW INVENTIONS TRANSFORMED THE INDUSTRIES OF THE NATION.

Wonderful as is the manufacturing system of this country, with its network of ramifications spread over the globe, it is of mushroom growth as compared with the history of the nation. It is little more than a century since the change came which supplanted for ever the ancient hand industries of the country. Hargraves, Arkwright, Crompton, Cartwright, and others, with the later assistance of Watt, struck the death-knell of all competing industrial systems, and laid the foundation for British commercial supremacy. The old system produced infinitely more skilled men than we—some of their products are the despair of modern imitation; but, aided by science and invention in utilizing the forces of nature, the manufacturers of England were able to flood the markets with the cheap products of organized mechanical industry, while our rivals, clinging to past traditions, holding on to past methods, worked their fingers to the bone in vain efforts to earn a living.

The triumphs of this remarkable movement were not simply those of England against other countries, but of those districts in England which adopted the new forces of production, as against those which resolutely clung to the old. One illustration will suffice. Norwich, which a hundred years ago was the centre of the wool industry and the most important manufacturing city in the country, refused to adapt itself to the new conditions. In previous times it had been able so to influence Parliament as to prohibit the import of rival productions from foreign countries, but it could influence no law of prohibition against the enterprise of rivals at home. Norwich fought against the progressive spirit of the age, as men fight against it now, and it is recorded that in the beginning of the century, "for any one to set up machinery in Norwich was to venture his life." The golden opportunity passed by, possibly never to return, and the great worsted industry deserted its ancient stronghold, and took root among the enterprising people of the West Riding of Yorkshire.

A statement follows showing the situation in the first years of the 19th Century, when the nations were at first involved in wars and later so impoverished by their struggles that, for awhile, their development was slow; the subsequent increase of the demand for raw material,

occasioned by rapid manufacture due to the new machinery, is shown; and the adoption by foreign countries of English methods,—the attention early given in these countries to the training of artisans, as their only hope for successful competition with England, is noted; then, after referring to the effect of the World's Fair of '51; and the wisdom of Prince Albert, and others, in attempting by the founding of The Science and Art Department at South Kensington, to provide for the technical and artistic training of the people, the writer considers at some length the causes of the hindrances met with in the efforts to promote the artistic development of the English people, and gives the follewing graphic picture of the existing conditions.

SLOW PROGRESS IN THE DEVELOPMENT OF ELEMENTARY TECHNICAL TRAINING.

But there were two great difficulties which impeded the success of the movement: apprentices were invited to study design who had never learned a stroke of drawing, and in many instances could neither read nor write; on the other hand, manufacturers, blinded by their prosperity (without art), viewed with perfect indifference and apathy the movement for the artistic training of their men, and only in exceptional instances supported it. The result is, that after thirty-five years of State encouragement and inspection, we have schools of art at present attended by about one in a thousand of our population, while the interest of the Educational Department in art culture is represented by the teaching of, "a little drawing" to one-fourth of the scholars in elementary schools. But recently in distributing the prizes at the Technical College of Bradford, Sir Henry Holland, the Minister then responsible for education, described the knowledge of drawing as "the right hand of the workman, and the mainspring of a technical education." Yet the humiliating fact must be admitted, that of all the children who are passing through the elementary schools of the country three-fourths are receiving no instruction in that subject which has beyond all others the most important bearing upon their future training as skilled workmen.

Our deficiencies in scientific knowledge were equally lamentable. Except for such instruction as masters and workmen obtained at Mechanics' Institutes or by private study the "rule of thumb" was universal. "A quarter of a century ago," said Professor Huxley in 1882, "in this country there was no machinery, State or other, for the diffusion of a knowledge of physical science among the people, unless we can regard the Mechanics' Institutions, with their sporadic and unsystematic popular lectures on scientific subjects, as something of the kind; and secondly, there was no means whatever by which any one belonging to the poorer or middle classes, who desired systematic scientific knowledge or scientific training, could obtain that knowledge or training."

ARTISTIC MANUFACTURES NOT THEN ATTEMPTED BY ENGLISHMEN.

What is chiefly remarkable in all this evidence of national ignorance of art or science is the fact, that for many years the great bulk of the industrial classes, both employers and employed, could not be made to believe that they were one penny the worse for it. Our insular pride and prejudice encouraged the fallacy that we commanded the machinery, the capital, the skill, and the knowledge, and therefore that success was assured, and could not but be enduring. We did not pretend to excel in the rich silks and velvets of Lyons, in the high-class cashmeres of the north of France, nor in the tasteful ornaments and fancy articles of Paris, Dresden, and Vienna. We claimed to be "*the manufacturers for the million*" all the world over, and in this respect our position was considered impregnable. The trade was simple, it was easy and profitable, and the world's markets were secured by the cheapness of our productions. What mattered if the designs upon our fabrics were ugly, the colours hideous, the dyeing and printing loose and bad? The goods had no rivals, or if one buyer refused them, two others were ready to take them; so, with all their faults, they were accepted East and West by customers who were eager to exchange corn and wine, and wool and cotton for them. There was no anxiety among manufacturers (and was never likely to be) to produce new patterns so long as there was plenty of demand for the old ones; but it must be allowed that in their desire for large profits some makers were not in the least concerned as to whether their goods would wear or their razors would shave, so long as they would sell.

It was from about this period that effective foreign competition gradually and almost imperceptibly began. The inventions of England were no longer England's monopoly: they were distributed over the world, and every new foreign factory that was built combined the latest English improvements with the equipment of our most modern machines.

After discoursing upon the effect on English commerce of the protective tariffs of other countries attention is directed to a most important fact of the present day, one that is sure to increase in importance with every advance in civilization, and which compels every people, who do not wish to be hopelessly distanced, to adopt technical training in artistic industries; a fact as significant in its application to the United States as to Great Britain.

THE GROWING DEMAND FOR ARTISTIC GOODS.

In all civilized countries there is a daily increasing proportion of the people who are influenced by the attractiveness as well as the cheapness of what they buy, and some of our manufacturing rivals on the Continent, by virtue of their scientific and artistic training, are producing novelties and tasteful articles, which are selected in preference to English goods, not only in neutral markets, but even in our own. In a word, our enterprising continental rivals beat us in their own countries in common goods by their tariffs, which make effective competition impossible, and then beat us abroad in some classes of superior goods by their skill, taste, and commercial aptitude—the qualities which they have so assiduously taught in their schools, and which have been so grossly neglected in ours.

Technical education has taught foreign manufacturers of all kinds how to adapt their goods to the wants of their customers, and how to lead or follow the constantly changing fashions. Commercial education has been equally useful to merchants and distributors, enabling them by a knowledge of foreign languages to come into direct contact and sympathy with producers on the one hand and distant consumers on the other, thereby promoting rapid interchange of ideas for mutual advantage. Distributors have learned from remote customers how to make up their wares so as to suit local weights, measures, or fancies, and in a hundred ways to gratify the whims of those for whose business they are catering. These matters may seem to be small and unimportant in themselves, but they are sufficient to turn the balance in all cases of choice, other conditions being equal, and we have seen many instances where refusal on the part of English manufacturers to alter a pattern or style in order to please a customer, and where, through English ignorance of foreign preferences or tastes in matters of detail, large orders have gone to France or Germany which otherwise would have come to England.

The competition to which English producers are subjected, and the results of the investigation undertaken by the Royal Commission on Technical Instruction into the causes of the superiority of some classes of foreign goods, are next considered.

The superiority of the foreign establishments is not in machinery, but in men; not in natural faculties, but in training. Nor is this superiority confined to solitary or unimportant industries; it applies not only to machine-work, but to hand-work, and to the highest branches of almost every manufactured commodity which enters into the domestic service of man. In textiles the attractiveness of the goods is often strikingly apparent as against English competing goods. The designing is more tasteful, the dyeing and finishing more effective; and the superior "selling quality" thus secured is undoubtedly due to the technical training of the designers and dyers, which they have received in splendid schools provided by legislatures and municipalities for the purpose. We should hesitate to express this judgment upon the products of foreign manufacturers and artisans were it the opinion of the Commissioners alone, but it is evidently the unbiased verdict of the British public, who purchase the foreign manufactures which the Commissioners saw produced on British machines, while at the same time similar machines in England are idle and English operatives out of employment, the bread being literally taken out of their mouths, while the capital of the manufacturers is being eaten away by this alarming competition.

Here is the kernel of the whole matter, and just as we have endeavoured to show that England was raised to her commanding position of wealth and prosperity through her inventions and machinery, and by the cheapness and excellence of her manufactures, so she is now in danger of losing her industrial prestige and the

means of the livelihood of her people *through the more effective use of her inventions and machinery* by her rivals, who are thereby securing the greater cheapness and excellence of their manufactures.

The writer again emphasizes the controlling influence of an educated taste upon the demand for goods, instancing the United States as evidence that the added cost occasioned by a protective tariff does not prevent the buying of costly artistic, in preference to low priced inartistic goods, and concludes with a strong statement of the pressing need of the careful development of artistic skill, if England is to retain her commercial prosperity.

IMPORTANCE OF ART QUALITIES IN MANUFACTURES.

The protective tariffs of the United States are probably the highest in the world, and yet no country at the present time buys so largely of the superior manufactures of other countries, simply from the fact that, through lack of technical instruction, these superior goods are not made at home. The people who are guided by an educated taste will buy excellence and beauty at a high price rather than ugliness at a low price * * * . In some of the higher branches of trade, however, in the blending of beauty with utility in our productions, and in giving a "fair-seeming" appearance to common goods, we are not only behind some of our continental rivals, but we are lamentably behind in the conditions which promote excellence. This matter is so important as to demand national attention and national action; it is vital to the wellbeing of all classes, and stands in the forefront of that movement to "organize victory" which Professor Huxley has so powerfully advocated.

The contest is being waged in every workshop and factory, and on every solitary bench in the world where work for sale is produced; and the world's wares are finally accepted or rejected on the shop counters where they are displayed. Every industry in the realm is affected by the preference of the customer for that which pleases the eye. Deficiency in aught is often equivalent to deficiency in all, and the faithful and earnest labour of the many may be practically wasted and rendered valueless by the lack of taste or knowledge of the few, who merely furnish the design or give the finishing touches to the work which the many have prepared. Therefore it is that we must look to the development of the brains of our people, to the discovery and training of talent for the public service in whatever ranks it may be found, for in the utilization of these qualities the weak links in our industrial chain may be strengthened, and the continued prosperity of the country secured.

THE COST TO A COUNTRY OF IGNORANCE.

In spite of the cry of extravagence in some quarters, the diminished statistics of juvenile crime and of pauperism, and the many evidences of growing intelligence, are impressing the people with the fact that it is not education but ignorance which is so costly, and that by improved education only can justice be done to the masses upon whose training as skilled workers and artizans the prosperity of the nation depends. The movement is rapidly growing upwards, and there are many signs that it is making progress downwards. The disposition to extend the benefits of university teaching to the masses was never greater than at the present time. It is true that the educational enthusiasm of the people in different districts of the country is unequal, and invariably the movement is slowest where education is most needed, and in the past has been most neglected. Yet we may point to this great achievement, that for the first time in history, and from end to end of the country, the burden of ignorance is being lifted from the child already struggling under the burden of poverty. In some districts of the country a chance of educational distinction has been placed within the reach of many; and it is to be hoped that before long it will be within the reach of all. The child of the labourer in the agricultural districts, of the factory operative in the crowded hives of the industrial North, the waifs and strays from the gutters and the slums of London and other large cities, are all attending school more or less regularly, and are receiving the prescribed dose of reading, writing, and arithmetic, before being turned out into the world to struggle for the remainder of their life's knowledge. The people of the country have not sufficiently appreciated the good work that has been achieved, or there would be an uncontrollable anxiety to extend its efficiency. No boy or girl can ultimately escape taking an absorbing interest in the means of his or her existence. The well-to-do must at least select a career, the poor know that they must work or starve. We plead for the introduction into our schools—beginning with the elementary and

continuing in the higher schools—of that scientific, commercial, and technical instruction which will develop the skill, taste, and efficiency of our workers, the enterprise of our distributers, and thus promote the manufacturing industry, and at the same time the prosperity of the country.

DRAWING AND ELEMENTARY INDUSTRIAL TRAINING ESSENTIAL.

In modifying our educational system in accordance with the industrial wants of the country, the changes necessary do not entail any serious revolutions. The great industries of the country are more or less localized in certain districts, and therefore the character of the special instruction need not be extensively varied. * * * In every school, without exception, drawing and appropriate elementary science should be taught. A course of instruction in the use of a few manual tools would be most useful to every schoolboy, with distinctive practical teaching where necessary, and theoretical instruction bearing upon the nature and properties of the various products connected with local industries. In every school in the country districts some of the elementary principles and facts of agriculture, and instruction in the use of tools, should be imparted. To girls the useful subject of needlework, the cutting out of clothing, &c.—already an important feature in their technical education—would be augmented by lessons in practical cookery, nursing the sick, and other subjects of domestic economy.

PRACTICAL SUGGESTIONS FOR THE PROMOTION OF ELEMENTARY INDUSTRIAL TRAINING.

Having regard to the position and prospects of the scholars, the manual instruction might be so arranged as not to be detrimental to their general intellectual progress; for example, in some instances it might be given out of school hours, and in the factory districts half-timers might be exempted from it on the ground that during a portion of each day they would be already receiving the best of all practical instruction, that of the factory or workshop. The imparting of instruction is not so much a question of time as of skill and method. From close observation in a manufacturing town, where the majority of the scholars from ten to thirteen in the Board schools are half-timers, we are able to state that, although they receive less than fourteen hours of instruction per week, and attend the factory for twenty-eight hours per week in addition, yet they pass with as high a percentage at the examinations as is secured by the average number of scholars throughout the country receiving double the amount of schooling. All educational conditions are greatly in favour of the full-time scholars, who are free from the supposed physical strain of factory labour, and have in addition ampler leisure for the preparation of their home lessons. Granting that the passing of examinations is not the only test of scholarship, as between full and half times, this illustration clearly demonstrates the fallacy of the argument that the children would necessarily fail in the essential subjects of reading, writing, and cyphering, if a few hours per week were abstracted for drawing, science, and physical exercises. Under skilful tuition, the rate of the half-timer's progress—boy or girl—bears no comparison to the curtailment of the school hours. The fact is, that the ambition of most operative children is roused the moment they can do something useful with their hands, and begin to earn wages. They are proud to become contributors to the family income, they enjoy the change from the school to the factory and from the factory to the school; and, as a rule, they take a healthier and fresher interest both in work and study than the full-timers. What is equally instructive is the fact that there is a greater readiness among apprentices who have been half-timers to attend evening classes, than among boys of the same ages who have not begun to work until they have left school. Indeed, the unfortunate and foolish idea still largely prevails among parents and scholars—not more confined to those who attend the lowest schools, than to those who go through the highest—that when they leave the day-school their education is finished. On this account, if on no other, an arrangement securing to all school boys a little manual training, and to all apprentices a little appropriate schooling, would be of incalculable value in promoting self-reliance, and in revealing the capacities of students and suggesting the means of turning them to useful account. But best of all, it would solve the problem of technical education, so far as the masses are concerned, by placing within their reach the systematic training of the mind and hand, with the inevitable result of making "the man a better mechanic, the mechanic a better man." * * *

THE NEED FOR ELEMENTARY INDUSTRIAL EDUCATION.

Place a modern schoolboy in office, and he is comparatively happy; the surroundings are appropriate, and accord more or less with his experience. Place him in a workshop or any manufacturing establishment, and for a time he is miserable. He has to begin life under new and perplexing conditions, unable to draw upon his antecedents for the least assistance. He never handled a chisel nor used a file; his clumsiness and his mistakes excite the laughter and ridicule of his merciless shop-mates; and he finds no occupation for the pen, the only useful implement which his fingers have been taught to use. Side by side with his fellows he can show nothing but the weak side of his training—or rather his lack of it altogether; and it is nobody's business to teach him the A B C of his practical calling, as important for the workman as the alphabet is for the schoolboy. It is not the apprentice, but the system which is at fault. For one boy intended for an office, a hundred are intended for some handicraft or mechanical occupation. We show our appreciation of the fitness of things by indifferently preparing the hundred boys for the office, and none for the workshop. The very character of their scholastic training repels them from the attractions of industrial life, and from the practice of handicrafts by which the future mechanical bent of the student is to be discovered, and his choice of a calling directed. The nation cries aloud for skilled artisans and efficient manufacturers; yet artisans and manufacturers are educated as if skilled traders were no longer needed, and clerk and literary men only were wanted. But even in this respect our schools are lamentably deficient when compared with those of Germany and Switzerland, where the principles of commerce and modern languages are systematically taught; as witness the thousands of German and Swiss clerks and correspondents, who by virtue of their knowledge of modern languages and the methods of commerce have secured the chief places in the merchants' offices of our own country.

SCHOOLS MUST DO WHAT APPRENTICESHIP NO LONGER DOES.

We cannot escape the condemnation excited by our defective education by claiming what is singularly inaccurate, that it is corrected by our apprenticeship system. In the earlier days of England's industrial fame every workshop was a technical school, and every apprentice learned his trade through years of skilful training. "We have changed all that," and our apprenticeship system is rapidly becoming abolished in order to give place to the highly organized system of division of labour which is the marked characteristic of our great industrial establishments. The arrangement undoubtedly has its advantages, from the point of view of exactness, mechanical finish, and economy of production, in the repetition of given patterns; but it cannot be regarded with satisfaction by those who desire to promote the efficiency of our men. Mr. Ruskin says: "It is not, truly speaking, the labour which is divided, but the men—divided into mere segments of men—broken into small fragments and crumbs of life; so that all the little piece of intelligence that is left in a man is not enough to make a pin or a nail, but exhausts itself in making the point of a pin or the head of a nail." The continental nations, by the teaching of drawing and modelling, elementary science and manual occupations, in their elementary schools, provide a basis for technical training which materially affects their whole plan of education, and acts directly upon their industries. By these means the boys and girls at an early age are interested in the development of their skill as a means of obtaining a livelihood; their instruction directs them to suitable callings, and a prepared constituency of young men is formed in every town for the technical schools and evening science and art classes which discerning Governments have lavishly founded for the scientific and artistic training of the captains and the rank and file of industrial enterprises, and which are attended by tens of thousands of students prepared to take advantage of and profit by the instruction.

INSTANCES OF SUCCESSFUL TECHNICAL SCHOOLS.

In several manufacturing centres of the country our deficiencies have been met by the establishment of technical schools and colleges, and by the utilization of existing means for providing scientific instruction. Some of these schools have passed through their experimental stage of existence, and their success has been sufficient to encourage vigorous action in other localities. In several of the populous towns of Lancashire and Yorkshire there is at the present time a laudable desire to celebrate the Jubilee of Her Majesty's reign by the establishment of technical schools. In our judgment no memorials of her illustrious reign can be so satisfactory to the Queen as the erection of buildings throughout the country devoted to the scientific and artistic training of her subjects. It is impossible that

we can at once build and organize full-blown technical schools, competing with those of the Continent, where the buildings are almost invariably erected at the public cost, while the annual deficit after the payment of low fees is provided in the same way. Even if this difficulty were overcome, as we have explained, neither the sons of employers nor the artisan students in this country have received appropriate preparatory training. The constituency is not prepared; there is a lamentable absence of technical teachers; the industrial communities as yet do not know what they want; and to those who attempt the work as on the Continent, in a manner worthy of its importance, the question of outlay, alarmingly disproportionate to income, will meet and discourage them at every turn. As yet, neither the School Boards nor other local authorities have power to establish and maintain such schools; but Sir Henry Roscoe, M. P., who was a member of the Royal Commission on Technical Instruction, has introduced a Bill into Parliament, the object of which is to empower School Boards or other municipal authorities, if they think fit, to provide technical and commercial schools, and contribute to their maintenance. These schools, in day and evening classes, will supply instruction, suitable for local industries, to employers, foremen and workmen, and also facilities by means of scholarships for receiving the most talented boys from the elementary schools, and passing them forward to such institutions as the Normal Schools of Science and Art at South Kensington, the Royal School of Mines, the Central Institution of the City and Guilds of London, or one or other of the provincial colleges. By the formation of technical and commercial schools of this character, sought by Sir Henry Roscoe—than whom no man has a larger knowledge of the educational machinery of other countries or the great needs of our own—the scheme of National Industrial and Commercial Education in this country will be placed within reach of its urgent necessities. * * *

HOW THE SCIENCE AND ART DEPARTMENTS AID LOCAL EFFORTS.

To those towns which are at the present time preparing for the building and organization of technical schools and colleges, and are anxious to receive all possible help from public sources, we would point out that already they may obtain from the Science and Art Department a building grant for approved accommodation for the teaching of art of 2s. 6d. per square foot, to the maximum extent of £500, and an equal grant of £500 for science. For approved furniture and fittings of science and art, and for a reference library of scientific books for the use of students, a grant may be obtained of 50 per cent. upon the cost. Important grants in aid of teaching art and science subjects by certificated teachers are offered, and local scholarships and royal exhibitions enable students of sufficient merit to receive at South Kensington and other colleges the highest instruction in art and science that the State can give, without cost to the students themselves. The character of the instruction is arranged so as to meet as far as possible the requirements of those connected with manufacturing industries, and the examinations are conducted by eminent men of science with the object of testing the practical acquaintance with the subject of each student, altogether apart from literary or other qualifications. The Bill of Sir Henry Roscoe asks for the further extension of the grants of the Science and Art Department to instruction in the use of ordinary tools, commercial arithmetic, commercial geography, bookkeeping, French, German, and other foreign languages. Such provision will materially promote the extension of technical and commercial instruction, and increase the income of the technical schools and evening classes already in existence.

In addition to the operations of the Science and Art Department there are also grants in aid of Technology, and on the successes of examinations conducted by the City and Guilds of the London Institute, for proficiency in the application of design and scientific principles to practical work in various trades of the country.

HOW ADMIRABLY THE CLOTHWORKERS' COMPANY OF LONDON PROMOTES TECHNICAL TRAINING.

The Building and Maintenance grants by the Clothworkers' Company of London to weaving and dyeing schools connected with the wool industry, are not only remarkable instances of generous munificence, but, considered in their relation to the stimulus thus given to important industrial centres to help themselves, they have rendered national service. It is but simple justice to record that the textile department of the Yorkshire College at Leeds owes its existence and annual maintenance entirely to the Clothworkers' Company; while the splendid Technical College of Bradford, the Technical School of Huddersfield, and the new wing of the Keighley Institute would probably never have been built but for the encouraging challenge to local effort in each instance that was given by the noble offers of assistance

on the part of this Company. To these four buildings alone, which represent an aggregate expenditure of over £100,000 the Clothworkers have contributed nearly £40,000 with grants towards their maintenance amounting to £2,700 annually, and at the present time they are rousing the public spirit of other Yorkshire towns by promises of liberal support to projected undertakings of a similar character. There is conclusive evidence that the wool industry of the country, affecting the means of livelihood of millions of her Majesty's subjects, has been quickened and developed by the timely extension of artistic, technical, and scientific knowledge among the designers, dyers, finishers, and others connected with the trade, through the grants of the Clothworkers' Company. This and other City companies, by extending their wealth upon the promotion of technical instruction among the industrial classes of several of our towns, have acted as pioneers in demonstrating its advantage to our commerce, and the Government could not more surely benefit the interests of commerce and agriculture than by devoting a reasonable proportion of the taxes to the development of the skill and intelligence of the artisans of the country, by whose labour the taxes are raised.

SUGGESTIONS FOR EQUIPMENT AND ORGANIZATION OF TECHNICAL SCHOOLS IN MANUFACTURING TOWNS.

Without necessarily following the model of the elaborately equipped schools of the Continent, the technical school of a manufacturing town should at least contain departments for science and art, with chemical laboratory, class rooms and lecture theatre, a library, a museum, and one or more departments with machinery or tools appropriate to the local industries. Teachers will be required for day classes in the various subjects, and for the evening classes which in this country naturally become the backbone of the system. But students need to be prepared for the technical classes, and for a time at least it would be desirable that the accommodation should be utilized as a day school, giving an ordinary education to advanced boys supplemented by the teaching of art and science subjects appropriate to the wants of the district, with the addition of workshop practice and modern languages. The fees should be sufficiently low to enable the workman who can dispense with his son's earnings till he is fifteen to send him to the school; but the teaching should be so thorough and appropriate as to make it worth the while of the employers to send their sons, at possibly a higher fee. There should be scholarships from elementary schools, admitting by public examinations the "cream" of the boys, and paying for their tuition. Private generosity might be relied upon to supplement the grants offered by the State, and thus enable talented boys, by royal exhibitions and other prizes, to pass from the local school to the Science College or Normal School of Art at South Kensington, and thus obtain the highest tuition without the cost of a penny to their parents. The technical departments should be arranged in accordance with the industrial requirements of the locality. The day scholars might be at liberty to select one or more technical subjects, or, in lieu thereof, a special commercial course, with systems of book-keeping, exchange, and modern languages. By such a curriculum, modified from time to time to suit local wants, each boy in the day-school would obtain a modern secondary education, in addition to some training in actual work at the bench, lathe, loom, or in the laboratory, illustrating the trade in which he would probably be called upon to earn his livelihood. As a matter of fact a nursery would be formed which would be constantly preparing students for the special technical courses; but more than this, the earnest student, on leaving the day-school and beginning his apprenticeship face to face with industrial problems and the great principles underlying his calling, would in many instances return to the night-school, knowing his deficiencies and how to remedy them, and continue his studies with a directness and profit altogether beyond the experience of the apprentice who had been deprived of such a preliminary training. * * *

THE KEIGHLEY TECHNICAL INSTITUTION: WHAT IT HAS ACCOMPLISHED.

Combined with the original building. the Keighley Technical Institute, at a total cost of £30,000, in a population of 30,000, will provide accommodation for 1,500 students in day and evening classes, and, under suitable organization, will supply the varied instruction that may be required from elementary to technical, commercial, and literary training, according to the tastes and capacities of the young men and women of all social grades who may be attracted to its classes. The experience of the last sixteen years enables us to measure the results of the system of day-school and evening classes under which the Institute has been worked. It has brought together employers and employed without distinction, and has popularized and raised the educational spirit of the town. The mechanic has found a school

open to him, in which poverty has presented no insuperable barrier to his own intellectual advancement, or that of his gifted child. By means of scholarship a well-defined path has been opened up for the progress of the industrious and the talented from the factory schools to the technical school; the teachers of elementary schools have striven for the honour of having trained the winners of the scholarships, and parents in many instances have been encouraged to take a livelier interest in their children's studies, and to make sacrifices in their behalf. The advantages afforded within and beyond the technical school have been substantial, and have been annually secured by many of those for whom they have been intended. An open career has been given to scores of artisans who are now holding positions of trust and responsibility, which, but for their superior and appropriate education, they could not have reached. From forty to fifty young artisans, some of them workers in machine-shops, attending night classes, others promoted by scholarships from half-time schools, have, by obtaining royal exhibitions, free studentships, or other prizes, been admitted within the last few years to the advantages of the Science College or the Normal School of Art at South Kensington. At these national institutions, and under the most distinguished professors, they have received the highest scientific and artistic instruction without entailing the cost of a penny upon their parents. The Keighley Institute for several years past has sent more students to South Kensington than any town in the country. And why? Not because the young artisans of Keighley are more gifted intellectually than those of other towns, but simply from the fact that the promoters of the Institute have utilized the machinery for State help that already exists; they have placed the educational ladder within reach of the talented and the industrious of the operative classes, and the ladder has been climbed. At the present time there are ambitious boys in every school and factory in the district who are preparing to compete for the distinction already achieved by so many who have arisen from the same humble sources. * * * As the most immediate and enduring protection of our national industries, we have urged the vast importance of developing the faculties of our men and women from childhood upwards; of introducing into our elementary schools drawing, elementary science, and manual exercises appropriate to the future needs of the scholars; of the establishment of technical and commercial schools furnished with apparatus, museums, &c.; with easy steps from the elementary schools, and provision for the advancement of gifted students to national or provincial colleges. Convinced as we are of the great value of theoretical instruction to English apprentices and artisans who happily enjoy more leisure than any in the world, we have strongly recommended the opening of evening classes in Technical schools as the sheet-anchor of our industrial education, as it applies to those most influenced by it, and we have favoured the extension of the powers of localities, and of grants from the State for the building and maintenance of technical, commercial, and agricultural schools. The struggle for existence among the masses of every country in Europe reveals the nature of the industrial warfare in which we are engaged, and shows the need of equipment on our part. We believe, however, that by the means above suggested, beyond all others, will English industries be further developed, and the English people advanced in civilization and in material well-being. * * *

LEGISLATION URGED TO PROMOTE ELEMENTARY TRAINING.

We have already indicated that the next step in legislation on this subject should provide for instruction in the use of a few simple tools to be given to all boys, and elementary science where suitable; that needlework should be taught to all girls, with the addition of cookery and simple subjects connected with household management. Further, that drawing should be taught in every school to boys and girls universally. Such instruction would supply the rudiments of a technical education for handicraftsmen, and would materially help all boys and girls irrespective of their intended career to be "handy." Drawing, needlework, and cookery are already recognized as subjects upon which grants may be made in elementary schools, and the Government Bill would have enabled localities to provide suitable accommodation and maintenance for the training of scholars in the use of tools, laboratory practice, and in other subjects not already recognized, but the requirement that each scholar receiving local aid should have passed the sixth standard was equivalent to making a gift with the one hand and taking it away with the other. Instruction of the above practical character cannot begin at too early an age. Experience shows that it should accompany book learning, not follow it. The study of things is more important than the study of words. Writing begins with childhood, why not drawing? In the *Kindergarten* infants are taught modelling, designing, straw-plaiting, &c., and sometimes the skill with which their little fingers shape familiar objects of use and ornament is a remarkable evidence of innate talent and artistic tendency.

EARLY ARTISTIC AND TECHNICAL TRAINING GIVEN TO CHILDREN IN FRANCE.

In France the faculties for design, colour, manual skill, &c., are trained from childhood, side by side with the literary faculty. And why? Because, as was often remarked to the Technical Commissioners, a boy may go through life unable to read or write, but he cannot maintain himself without the use of his hands, and, in proportion as he can use his hands skillfully and tastefully, he becomes a more valuable workman. * * *

It is to be hoped that the new Bill will make definite provision for the establishment and maintenance, as on the Continent, of graded schools in all populous localities, with systematic steps for the promotion of the talented among the poor from elementary to secondary, and even to the highest schools or colleges. The organization of secondary instruction cannot much longer be neglected, and as the reorganized grammar schools still lean, in most instances, in their teaching to the classical side, the new schools might advantageously supplement an ordinary English education by manual, technical, agricultural, or commercial training, according to the wants of the locality. In manufacturing and mercantile towns the character of the technical and commercial instruction would bear upon the local industries and requirements. In agricultural centres the technical instruction would have a proportionate bearing upon agriculture. * * *

THE OPENING OF EVENING TRAINING SCHOOLS URGED.

One great hope of a Technical Education Bill lies in the prospect thereby raised of more extended and useful evening instruction. In towns where technical day schools are not already in existence, provision should be made in the day elementary, and secondary schools for evening classes, with grants for the new subjects suggested, and if possible with free admission to artisans. Existing technical schools, and the accommodations at the larger mechanics' institutes and kindred societies, might with great advantage be organized as secondary day schools, with assistance from local rates in accordance with satisfactory representation of the rating authority on the governing body of each assisted school. As we have already observed, the artisans and others attending at night, after their workshop practice during the day, would, as a rule, require but little, if any, practical instruction, their necessities being more in the direction of theoretical or artistic knowledge. It is for those who, having learned the rudiments of science and art in the day school, and have become apprenticed to some handicraft or trade, that the technical evening schools are of such vast importance. It is here also where English youths have such a substantial advantage over all their rivals in every country. The leisure of the English apprentice and artisan is greater by from six to eighteen hours per week than that of his rivals in America or on the Continent. The efficient use of this all-powerful resource would enable our manufacturers and artisans to strengthen the weak points in our industrial chain, and thus to resist the growing competition of our rivals.

THE TEACHING OF ELEMENTARY SCIENCE IN DAY SCHOOLS AND OF TECHNICAL TRAINING IN NIGHT SCHOOLS RECOMMENDED.

We have the greatest faith in the ultimate usefulness of these technical night schools. The success already achieved by night schools in all parts of the country is a happy augury of still greater results that will follow when teachers are more thoroughly trained, when students are better prepared, and when the deficiency of income over expenditure is provided by the local rate.

It will be found to be of more advantage that those who teach theory should understand practice, and that those who are engaged in practice should understand theory. Let science and art be systematically taught in day schools, and the useful arts become the acquisition of all, and the problem of technical instruction for our artisans will be solved in the night schools. The Technical Commissioners were deeply impressed by the practical character of the instruction in many of these night schools in foreign lands. To quote an example; they found in a free night school of over 400 students, that the director, a proficient artist, had under him a staff of assistants, all of whom were earning their living in the day time by the practical application of the arts which they were teaching in the night school. The teacher of mechanical drawing was a practical draughtsman from an engineering establishment; building construction was taught by a foreman builder; ornamental drawing by a decorator. One of the teachers was a designer of cabinet furniture, another of bronze ornaments and metal work; modelling was taught by a practical sculptor, while the life class was under the immediate supervision of the director. With appropriate preliminary training we would ask for nothing more—while at

the same time we ought not to be content with anything less—in the manufacturing towns of England than free night schools of the above character, attended by the young men from the machine shops, building works, factories, warehouses, and small trades. These technical teachers, coming direct from manufacturing establishments, in line with the changing wants of the day, were able to impart life and spirit to their tuition, and bring their students into contact with the teachings of art and science through the familiar terms and language of their daily life. We sincerely hope that a Technical and Commercial Education Bill will soon again be presented to Parliament, and that by a judicious blending of imperial and local support it will insure to all classes in the United Kingdom, an education not less appropriate for the work of life of the people than is demanded by the circumstances of this great country, which has so much to lose by the neglect, and so much to gain by the cultivated efficiency of its people. * * *

IV.

National Association for the Promotion of Technical Education.

President, Marquis of Hartington, M. P.
Treasurer, Sir P. Lubbock, M. P.
Secretaries, Sir H. E. Roscoe, M. P.; Mr. A. H. D. Acland, M. P.
All communications to be addressed to Arthur H. D. Acland, M. P., 35 Cadogan Terrace, London, S. W.

OFFICAL STATEMENT OF THE OBJECTS OF THE ASSOCIATION.

At an Inaugural Meeting held in London on July 1, which was addressed by Lord Hartington, Sir Lyon Playfair, Mr. John Morley, Sir John Lubbock, Mr. Mundella, Lord Rosebery, Sir Bernhard Samuelson, Mr. George Howell, Sir M. Kay-Shuttleworth, Mr. George Dixon, Professor Garnett, Mr. Jesse Collings, Professor Bodington, Mr. Samuel Smith, and others, the following statement in relation to the Objects of the Association was agreed upon:

In view of the general expression of opinion throughout the country as to the necessity of a reform of our system of National Education, with the object of giving it a more practical direction, it has been resolved to form a National Association for the Promotion of Technical (*including Commercial and Agricultural*) Education. The general aim of the Association will be to bring into force the recommendations already made by several Royal Commissions, as well as to effect such reforms in our educational system as will develop in the best way the intelligence of those of all classes upon whom our industries depend.

The following objects will engage the early attention of the Association:

1. The encouragement of Educational Reform, whether by legislation or otherwise, to be carried out by the following amongst other means:

(*a*) The promotion in our primary schools of the better training of the hand and eye by improved instruction in drawing, in the elements of science, and the elementary use of tools.

(*b*) The introduction of such changes in the present system of primary instruction as may be necessary to enable children to take advantage of technical teaching.

(*c*) The more extended provision of higher elementary schools, where technical education may be provided for those who are fit to take advantage of it.

(*d*) The reform of the present system of Evening Schools, with special provisions for the encouragement of Technical (including Commercial and Agricultural) Instruction.

(*e*) The development, organization, and maintenance of a system of Secondary Education throughout the country, with a view to placing the higher Technical and Commercial Education in our Schools and Colleges on a better footing.

(*f*) The improvement of the training of teachers, so that they may take an effective part in the work which the Association desires to forward.

2. The formation of a central consultative body, which will give opportunities for conference between persons of various classes and from different localities, will form and influence public opinion, and will obtain public support for the furtherance of Technical Education.

3. The collection of information as to the existing means for carrying out the work of Technical Education, and the best methods of extending and organizing it throughout the United Kingdom.

4. The preparation, in a popular form, of information to be obtained from Reports of Commissions, Consular Reports, and from various other sources (including, if necessary, special inquiries at home and abroad), for diffusion throughout the country. By these and other means the Association desires to bring about the organization and co-ordination of the Industrial Education of both sexes in accordance with the needs of various localities.

The Association has no intention whatever of interfering with existing institutions. It desires to spread information as to the work which is already being done, and to stimulate in every possible way a desire among the public at large for further development on the broadest lines of Technical Education in all its branches.

SUB-COMMITTEES.

The Executive Committee have made arrangements for the formation of Sub-Committees in connection with the following subjects:

Technical Education in relation to Elementary Schools.
Higher Technical Education.
Technical Education in relation to Agriculture.
Commercial Education.

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HENRY E. ROSCOE,
ARTHUR H. D. ACLAND,
Secretaries.

SEPT., 1887.

V.

ADDRESS DELIVERED BY PROFESSOR HUXLEY, F. R. S., AT A MEETING HELD IN THE TOWN HALL, MANCHESTER, NOV. 29TH, 1887. *

MR. MAYOR AND GENTLEMEN.—It must be a matter of sincere satisfaction to those who, like myself, have for many years past been convinced of the vital importance of technical education to this country to see that that subject is now being taken up by some of the most important of our manufacturing towns. The evidence which is afforded of the public interest in the matter by such meetings as those at Liverpool and Newcastle, and, last but not least, by that at which I have the honour to be present to-day, may convince us all, I think, that the question has passed out of the region of speculation into that of action. I need hardly say to anyone here that the task which our Association contemplates is not only one of primary importance—I may say of vital importance—to the welfare of the country; but that it is one of great extent and of vast difficulty. There is a well-worn adage that those who set out upon a great enterprise would do well to count the cost. I am not sure that this is always true. I think that some of the very greatest enterprises in this world have been carried out successfully simply because the people who undertook them did not count the cost; and I am much of opinion that, in this very case, the most instructive consideration for us is the cost of doing nothing. But there is one thing that is perfectly certain, and it is that, in undertaking all enterprises, one of the most important conditions of success is to have a perfectly clear comprehension of what you want to do—to have that before your minds before you set out, and from that point of view to consider carefully the measures which are best adapted to the end.

COMPREHENSIVE PURPOSES OF THIS MOVEMENT.

Mr. Acland has just given you an excellent account of what is properly and strictly understood by technical education; but I venture to think that the purpose of this Association may be stated in somewhat broader terms, and that the object we have in view is the development of the industrial productivity of the country to the uttermost limits consistent with social welfare. And you will observe that,

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*The meeting at which this address was delivered was called by the Mayor of Manchester, to consider the proposals of the National Association for the Promotion of Technical Education, and take action thereon. After a few words from the Mayor and from Mr. A. H. D. Acland, M. P., one of the Secretaries of the National Association, Professor Huxley delivered his address. The following motions were then carried:

1. A motion recommending the formation of local branches, or allied Associations throughout the district, to act with the National Association. Speakers: Mr. Ascroft (Preston), Mr. W. Mather, Sir M. Kay-Shuttleworth, M. P.
2. A motion for the formation of a General Committee for the district. Speakers: Sir H. Roscoe, M. P., Sir W. H. Houldsworth, M. P., Mr. R. D. Darbishire.
3. Vote of thanks to Professor Huxley. Speakers: Sir Joseph Lee, Professor Ward.

In speaking to the second resolution, Mr. R. D. Darbishire announced, on behalf of the Whitworth Trust Committee, that they had bought a plot of land in Manchester, commonly known as Potter's Park for £47,000, and this they had offered to the Corporation of Manchester, upon condition that the city should set aside two-thirds for the purpose of a public park, and that the other one-third should be set apart as a site for an art gallery, a museum of commercial materials and products, and a technical school.

in thus widening the definition of our object, I have gone no further than the Mayor in his speech, when he not obscurely hinted—and most justly hinted—that in dealing with this question there are other matters than technical education, in the strict sense to be considered.

It would be extreme presumption on my part if I were to attempt to tell an audience of gentlemen intimately acquainted with all branches of industry and commerce, such as I see before me, in what manner the practical details of the operations that we propose are to be carried out. I am absolutely ignorant both of trade and of commerce, and upon such matters, I cannot venture to say a solitary word. But there is one direction in which I think it possible I may be of service—not much perhaps, but still of some,—because this matter, in the first place, involves the consideration of methods of education with which it has been my business to occupy myself during the greater part of my life; and, in the second place, it involves attention to some of those broad facts and laws of nature with which it has been my business to acquaint myself to the best of my ability. And what I think may be possible is this, that if I succeed in putting before you—as briefly as I can, but in clear and connected shape—what strikes me as the programme that we have eventually to carry out, and what are the indispensible conditions of success, that that proceeding, whether the conclusions at which I arrive to be such as you approve or as you disapprove, will nevertheless help to clear the course. In this and in all complicated matters we must remember a saying of Bacon, which may be freely translated thus: "Consistent error is very often vastly more useful than muddle-headed truth." At any rate, if there be any error in the conclusions I shall put before you, I will do my best to make the error perfectly clear and plain.

A THREEFOLD PROBLEM.

Now, looking at the question of what we want to do in this broad and general way, it appears to me that it is necessary for us, in the first place, to amend and improve our system of primary education in such a fashion as will make it a proper preparation for the business of life. In the second place, I think we have to consider what measures may best be adopted for the development to its uttermost of that which may be called technical skill; and, in the third place, I think we have to consider what other matters there are for us to attend to, what other arrangements have to be kept carefully in sight in order that, while pursuing these ends, we do not forget that which is the end of civil existence, I mean a stable social state without which all other measures are merely futile, and, in effect, modes of going faster to ruin.

You are aware—no people should know the fact better than Manchester people—that, within the last seventeen years, a vast system of primary education has been created and extended over the whole country. I had some part in the original organization of this system in London, and I am glad to think that after all these years I can look back upon that period of my life as perhaps the part of it least wasted.

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No one can doubt that this system of primary education has done wonders for our population; but, from our point of view, I do not think anybody can doubt that it still has very considerable defects. It has the defect which is common to all the educational systems which we have inherited—it is too bookish, too little practical. The child is brought too little into contact with actual facts and things, and as the system stands at present it constitutes next to no education of those particular faculties which are of the utmost importance to industrial life—I mean the faculty of observation, the faculty of working accurately, of dealing with things instead of with words. I do not propose to enlarge upon this topic, but I would venture to suggest that there are one or two remedial measures which are imperatively needed; indeed, they have already been alluded to by Mr. Acland.

IMPORTANCE OF DRAWING AS A REQUIRED STUDY IN ALL SCHOOLS.

Those which strike me as of the greatest importance are two, and the first of them is the teaching of drawing. In my judgment, there is no mode of exercising the faculty of observation and the faculty of accurate reproduction of that which is observed, no discipline which so readily tests error in these matters, as drawing, properly taught. And by that I do not mean artistic drawing. I mean figuring natural objects: making plans, and sections, approaching geometrical rather than artistic drawing. I do not wish to exaggerate, but I declare to you that, in my judgment, the child who has been taught to make an elevation, plan and section of a pint pot has had an admirable training in accuracy of eye and hand. I am not talking about artistic education. That is not the question. Accuracy is the foundation of

everything else, and instruction in artistic drawing is something which may be put off till a later stage. Nothing has struck me more in the course of my life than the loss which persons, who are pursuing scientific knowledge of any kind, sustain from the difficulties which arise because they never have been taught elementary drawing; and I am glad to say that in Eton, a school of whose governing body I have the honour of being a member, we some years ago made drawing imperative on the whole school.

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The other matter in which we want some systematic and good teaching is what I have hardly a name for, but which may best be explained as a sort of developed object lessons such as Mr. Acland adverted to. Anybody who knows his business in science can make anything subservient to that purpose. You know it was said of Dean Swift that he could write an admirable poem upon a broomstick, and the man who has a real knowledge of science can make the commonest object in the world subservient to an introduction to the principles and greater truths of natural knowledge.

HOW ELEMENTARY SCIENCE SHOULD BE TAUGHT.

It is in that way that your science must be taught if it is to be of real service. Do not suppose any amount of book work, any repetition by rote of catechisms and other abominations of that kind are of value for our object. That is mere wasting of time. But take the commonest object and lead the child from that foundation to such truths of a higher order as may be within his grasp. With regard to drawing, I do not think there is any practical difficulty; but in respect to the scientific object lessons you want teachers trained in a manner different from that which now prevails.

If it is found practicable to add further training of the hand and eye by instruction in modelling or in simple carpentry, well and good. But I should stop at this point. The elementary schools are already charged with quite as much as they can do properly; and I do not believe that any good can come of burdening them with special technical instruction. Out of that, I think, harm would come.

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Now, let me pass to my second point, which is the development of technical skill. Everybody here is aware that at this present moment there is hardly a branch of trade or commerce which does not depend, more or less directly, upon some department or other of physical science, which does not involve, for its successful pursuit, reasoning from scientific data. Our machinery, our chemical processes or dye-works, and a thousand operations which it is not necessary to mention, are all directly and immediately connected with science. You have to look among your workmen and foremen for persons who shall intelligently grasp the modifications, based upon science, which are constantly being introduced into these industrial processes. I do not mean that you want professional chemists, or physicists, or mathematicians, or the like, but you want people sufficiently familiar with the broad principles which underlie industrial operations to be able to adapt themselves to new conditions. Such qualifications can only be secured by a sort of scientific instruction which occupies a midway place between those primary notions given in the elementary schools and those more advanced studies which would be carried out in the technical schools.

PROFESSOR HUXLEY DEFENDS THE SCIENCE AND ART DEPARTMENT.

You are aware that, at present, a very large machinery is in operation for the purpose of giving this instruction. I don't refer merely to such work as is being done at Owens College here, for example, or at other local colleges. I allude to the larger operations of the Science and Art Department, with which I have been connected for a great many years. I constantly hear a great many objections raised to the work of the Science and Art Department. If you will allow me to say so, my connection with that department—which, I am happy to say, remains, and which I am very proud of—is purely honorary; and, if it appeared to me to be right to criticise that department with merciless severity, the Lord President, if he were inclined to resent my proceedings, could do nothing more than dismiss me. Therefore you may believe that I speak with absolute impartiality. My impression is this, not that it is faultless, nor that it has not various defects, nor that there are not sundry *lacunæ* which want filling up; but that, if we consider the conditions under which the department works, we shall see that certain defects are inseparable from those conditions. People talk of the want of flexibility of the Department, of its being bound by strict rules. Now, will any man of common sense who has had anything to do with the administration of public funds or knows the humour of the House of Commons on these matters—will any man who is in

the smallest degree acquainted with the practical working of State departments of any kind, imagine that such a department could be other than bound by minutely defined regulations? Can he imagine that the work of the department should go on fairly and in such a manner as to be free from just criticism, unless it were bound by certain definite and fixed rules? I cannot imagine it.

The next objection of importance that I have heard commonly repeated is that the teaching is too theoretical, that there is insufficient practical teaching. I venture to say that there is no one who has taken more pains to insist upon the comparative uselessness of scientific teaching without practical work than I have; I venture to say that there are no persons who are more cognizant of these defects in the work of the Science and Art Department than those who administer it. But those who talk in this way should acquaint themselves with the fact that proper practical instruction is a matter of no small difficulty in the present scarcity of properly taught teachers, that it is very costly, and that, in some branches of science, there are other difficulties which I won't allude to. But it is a matter of fact that, wherever it has been possible, practical teaching has been introduced, and has been made an essential element in examination; and no doubt if the House of Commons would grant unlimited means, and if proper teachers were to hand, as thick as blackberries, there would not be much difficulty in organizing a complete system of practical instruction and examination ancillary to the present classes. Those who quarrel with the present state of affairs would be better advised if instead of groaning over the shortcomings of the present system, they would put before themselves these two questions—Is it possible under the conditions to invent any better system? Is it possible under the conditions to enlarge the work of practical teaching and practical examination which is the one desire of those who administer the department? That is all I have to say upon that subject.

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Supposing we have this teaching of what I may call intermediate science, what we want next is technical instruction, in the strict sense of the word technical; I mean instruction in that kind of knowledge which is essential to the successful prosecution of the several branches of trade and industry. Now, the best way of obtaining this end is a matter about which the most experienced persons entertain very diverse opinions. I do not for one moment pretend to dogmatize about it; I can only tell you what the opinion is that I have formed from hearing the views of those who are certainly best qualified to judge, from those who have tested the various methods of conveying this instruction.

THREE FORMS OF TECHNICAL SCHOOLS POSSIBLE.

I think we have before us three possibilities. We have, in the first place, trade schools—I mean schools in which branches of trade are taught. We have, in the next place, schools attached to factories for the purpose of instructing young apprentices and others who go there, and who aim at becoming intelligent workmen and capable foremen. We have, lastly, the system of day classes and evening classes. With regard to the first there is this objection, that they can be attended only by those who are not obliged to earn their bread, and consequently that they will reach only a very small fraction of the population. Moreover, the expense of trade schools is enormous, and those who are best able to judge assure me that, inasmuch as the work which they do is not done under conditions of pecuniary success or failure, it is apt to be too amateurish and speculative, and that it does not prepare the worker for the real conditions under which he will have to carry out his work. In any case, the fact that the schools are very expensive, and the fact that they are accessible only to a small portion of the population, seem to me to constitute a very serious objection to them. I suppose the best of all possible organizations is that of a school attached to a factory, where the employer has an interest in seeing that the instruction given is of a thoroughly practical kind, and where the pupils pass gradually by successive stages to the position of actual workmen. Schools of this kind exist in various parts of the country, but it is obvious that they are not likely to be reached by any large part of the population; so that it appears to me we are shut up practically to schools accessible to those who are earning their bread, and in such cases they must be essentially evening classes. I am strongly of opinion that classes of this kind do an immense amount of good, and that they have the admirable quality that they involve voluntary attendance, take no man out of his position, but enable any who chooses to make the best of the position he happens to occupy.

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Suppose that all these things are desirable, what is the best way of obtaining them? I must confess that I have a strong prejudice in favour of carrying out undertakings of this kind, which at first, at any rate, must be to a great extent tentative and experimental, by private effort.

TECHNICAL EDUCATION STILL IN THE EXPERIMENTAL STAGE OF DEVELOPMENT.

I don't believe that the man lives at this present time who is competent to organize a final system of technical education. I believe that all attempts made in that direction must for many years to come be experimental, and that we must get to success through a series of blunders. Now that work is far better performed by private enterprise than in any other way. But there is another method which I think is permissible, and not only permissible but highly recommendable in this case, and that is the method of allowing the locality itself in which any branch of industry is pursued to be its own judge of its own wants, and to tax itself under certain conditions for the purpose of carrying out any scheme of technical education adapted to its needs. I am aware that there are many extreme theorists of the individualist school who hold that all this is very wicked and very wrong, and that by leaving things to themselves they will get right. Well my experience of the world is that things left to themselves don't get right. I believe it to be sound doctrine that a municipality—and the State itself for that matter—is a corporation existing for the benefit of its members, and that here, as in all other cases, it is for the majority to determine that which is for the good of the whole, and to act upon that. That is the principle which underlies the whole theory of government in this country, and if it is wrong we shall have to go back a long way. But you may ask me, "This process of local taxation can only be carried out under the authority of Act of Parliament, and do you propose to let any municipality or any local authority have *carte blanche* in these matters; is the Legislature to allow it to tax the whole body of its members to any extent it pleases and for any purposes it pleases?" I should reply, certainly not.

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Let me point out to you that at this present moment it passes the wit of man, so far as I know, to give a legal definition of technical education. If you expect to have an Act of Parliament with a definition which shall include all that ought to be included, and exclude all that ought to be excluded, I think you will have to wait a very long time. I imagine the whole matter is in a tentative state. You don't know what you will be called upon to do, and so you must try and you must blunder. Under these circumstances it is obvious that there are two alternatives. One of these is to give a free hand to each locality. Well, it is within my knowledge that there a good many people with wonderful, strange, and wild notions as to what ought to be done in technical education, and it is quite possible that in some places, and especially in small places, where there are few persons who take an interest in these things, you will have very remarkable projects put forth, and in that case the sole court of appeal for those taxpayers, who did not approve of such projects, would be a court of law. I suppose the judges would have to settle what is technical education. That would not be an edifying process, I think, and certainly it would be a very costly one. The other alternative is the principle adopted in the bill of last year now abandoned. I don't say whether the bill was right or wrong in detail. I am dealing now only with the principle of the bill, which appears to me to have been very often misunderstood. It has been said that it gave the whole of technical education into the hands of Science and Art Department. It appears to me nothing could be more unfounded than that assertion. All I understand the Government proposed to do was to provide some authority who should have power to say in case any scheme was proposed, "Well, this comes within the four corners of the Act of Parliament, work it as you like;" or if it was an obviously questionable project, should take upon itself the responsibility of saying "No, that is not what the Legislature intended; amend your scheme." There was no initiative, no control, there was simply this power of giving authority to decide upon the meaning of the Act of Parliament to a particular department of the State, whichever it might be; and it seems to me that that is a very much simpler and better process than relegating the whole question to the law courts. I think that here, or anywhere else, people must be extremely sanguine if they suppose that the House of Commons and the House of Lords will ever dream of giving any local authority unlimited power to tax the inhabitants of a district for any object it pleases. I should say that was not in the range of practical politics. Well, I put that before you as a matter for your consideration.

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WISE WORDS CONCERNING TEACHING AND TEACHERS.

Another very important point in this connection is the question of the supply of teachers. I should say that is one of the greatest difficulties which beset the whole problem before us. I do not wish in the slightest degree to criticise the existing system of preparing teachers for ordinary school work. I have nothing to say

about it. But what I do wish to say, and what I trust I may impress on your minds firmly, is this, that for the purpose of obtaining persons competent to teach science or to act as technical teachers, a different system must be adopted. For this purpose a man must know what he is about thoroughly, and be able to deal with his subject as if it were the business of his ordinary life. For this purpose, for the obtaining of teachers of science and of technical classes, the system of catching a boy or girl young, making a pupil teacher of him, compelling the poor little mortal to pour from his little bucket into a still smaller bucket that which has just been poured into it out of a big bucket; and passing him afterwards through the training college, where his life is devoted to filling the bucket from the pump from morning to night, without time for thought or reflection, is a system which should not continue. Let me assure you that it will not do for us, that you had better give the attempt up than try that system. I remember somewhere reading of an interview between the poet Southey and a good Quaker. Southy was a man of marvellous powers of work. He had a habit of dividing his time into little parts each of which was filled up, and he told the Quaker what he did in this hour and that, and so on through the day until far into the night. The Quaker listened, and at the close said, "Well, but, friend Southey, when dost thee think?" The system which I am now adverting to is arraigned and condemned by putting that question to it. When does the unhappy pupil teacher or overdrilled student of a training college find any time to think? I am sure if I were in their place I could not. I repeat, that kind of thing will not do for science teachers. For science teachers must have knowledge, and knowledge is not to be acquired on these terms. The power of repetition is, but that is not knowledge. The knowledge which is absolutely requisite in dealing with young children is the knowledge you possess, as you would know your own business, and which you can just turn about as if you were explaining to a boy a matter of everyday life.

So far as science teaching and technical education are concerned, the most important of all things is to provide the machinery for training proper teachers. The Department of Science and Art has been at that work for years and years, and though unable under present conditions to do so much as could be wished, it has I believe, already begun to leaven the lump to a very considerable extent. If technical education is to be carried out on the scale at present contemplated, this particular necessity must be specially and most seriously provided for. And there is another difficulty, namely, that when you have got your science or technical teacher it may not be easy to keep him. You have educated a teacher it may not be easy to keep him. You have educated a man—a clever fellow very likely—under the understanding that he is to be a teacher. But the business of teaching is not a very lucrative and not a very attractive one, and an able man who has had a good training is under extreme temptations to carry his knowledge and his skill to a better market, in which case you have had all your trouble for nothing. It has often occurred to me that probably nothing would be of more service in this matter than the creation of a number of not very large bursaries or exhibitions, to be gained by persons nominated by the authorities of the various science colleges and schools of the country—persons such as they thought to be well qualified for the teaching business—and to be held for a certain term of years, during which the holders should be bound to teach. I believe that some measure of this kind would do more to secure a good supply of teachers than anything else. Pray note that I do not suggest that you should try to get hold of good teachers by competitive examination. That is not the best way of getting men of that special qualification. An effectual method would be to ask professors and teachers of any institution to recommend men who, to their own knowledge, are worthy of such support, and are likely to turn it to good account.

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TECHNICAL TRAINING ALONE NOT ALL SUFFICIENT FOR A PEOPLE.

I trust I am not detaining you too long; but there remains yet one other matter which I think is of profound importance, perhaps of more importance than all the rest, on which I earnestly beg to be permitted to say some few words. It is the need, while doing all these things, of keeping an eye, and an anxious eye, upon those measures which are necessary for the preservation of that stable and sound condition of the whole social organism which is the essential condition of real progress, and a chief end of all education. You will all recollect that some time ago there was a scandal and a great outcry about certain cutlasses and bayonets which had been supplied to our troops and sailors. These warlike implements were polished as bright as rubbing could make them; they were very well sharpened; they looked lovely. But when they were applied to the test of the work of war they broke and they bent, and proved more likely to hurt the hand of him that used

them than to do any harm to the enemy. Let me apply that analogy to the effect of education which is a sharpening and polishing of the mind. You may develop the intellectual side of people as far as you like, and you may confer upon them all the skill that training and instruction can give; but, if there is not underneath all that outside form and superficial polish the firm fibre of healthy manhood and earnest desire to do well, your labour is absolutely in vain.

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THE STRUGGLE FOR EXISTENCE.

Let me further call your attention to the fact that the terrible battle of competition between the different nations of the world is no transitory phenomenon, and does not depend upon this or that fluctuation of the market, or upon any condition that is likely to pass away. It is the inevitable result of that which takes place throughout nature and affects man's part of nature as much as any other—namely, the struggle for existence, arising out of the constant tendency of all creatures in the animated world to multiply indefinitely. It is that, if you look at it, which is at the bottom of all the great movements of history. It is that inherent tendency of the social organism to generate the causes of its own destruction, never yet counteracted, which has been at the bottom of half the catastrophes which have ruined States. We are at present in the swim of one of those vast movements in which, with a population far in excess of that which we can feed, we are saved from a catastrophe, through the impossibility of feeding them, solely by our possession of a fair share of the markets of the world. And in order that that fair share may be retained, it is absolutely necessary that we should be able to produce commodities which we can exchange with food-growing people, and which they will take, rather than those of our rivals, on the ground of their greater cheapness or of their greater excellence. That is the whole story. And our course, let me say, is not actuated by mere motives of ambition or by mere motives of greed. Those doubtless are visible enough on the surface of these great movements, but the movements themselves have far deeper sources. If there were no such things as ambition and greed in this world the struggle for existence would arise from the same causes.

THE PROBLEM WHICH CONFRONTS ALL MODERN CIVILIZATION.

Our sole chance of succeeding in a competition, which must constantly become more and more severe, is that our people shall not only have the knowledge and the skill which are required, but that they shall have the will and the energy and the honesty, without which neither knowledge nor skill can be of any permanent avail. This is what I mean by a stable social condition, because any other condition than this, any social condition in which the development of wealth involves the misery, the physical weakness, and the degradation of the worker, is absolutely and infallibly doomed to collapse. Your bayonets and cutlasses will break under your hand, and there will go on accumulating in society a mass of helpless, physically incompetent, and morally degraded people, who are, as it were, a sort of dynamite which, sooner or later, when its accumulation becomes sufficient and its tension intolerable, will burst the whole fabric.

I am quite aware that the problem which I have put before you and which you know as much about as I do, and a great deal more probably, is one extremely difficult to solve. I am fully aware that one great factor in industrial success is reasonable cheapness of labour. That has been pointed out over and over again, and is in itself an axiomatic proposition. And it seems to me that of all the social questions which face us at this present time, the most serious is how to steer a clear course between the two horns of an obvious dilemma. One of these is the constant tendency of competition to lower wages beyond a point at which man can remain man—below a point at which decency and cleanliness and order and habits of morality and justice can reasonably be expected to exist. And the other horn of the dilemma is the difficulty of maintaining wages above this point consistently with success in industrial competition. I have not the remotest conception how this problem will eventually work itself out; but of this I am perfectly convinced, that the sole course compatible with safety lies between the two extremes; between the Scylla of successful industrial production with a degraded population, on the one side, and the Charybdis of a population, maintained in a reasonable and decent state, with failure in industrial competition, on the other side. Having this strong conviction, which, indeed, I imagine must be that of every person who has ever thought seriously about these great problems, I have ventured to put it before you in this bare and almost cynical fashion because it will justify the strong appeal, which I make to all concerned in this work of promoting industrial education, to have a

care, at the same time, that the conditions of industrial life remain those in which the physical energies of the population may be maintained at a proper level; in which their moral state may be cared for; in which there may be some rays of hope and pleasures in their lives; and in which the sole prospect of a life of labour may not be an old age of penury.

These are the chief suggestions I have to offer to you, though I have omitted much that I should like to have said, had time permitted. It may be that some of you feel inclined to look upon them as the Utopian dreams of a student. If there be such, let me tell you that there are, to my knowledge, manufacturing towns in this country, not one-tenth the size, or boasting one hundredth part of the wealth, of Manchester, in which I do not say that the programme that I have put before you is completely carried out, but in which, at any rate, a wise and intelligent effort has been made to realize it, and in which the main parts of the programme are in course of being worked out. This is not the first time that I have had the privilege and pleasure of addressing a Manchester audience. I have often enough before now thrown myself with entire confidence upon the hard-headed intelligence and the very soft-hearted kindness of Manchester people, when I have had a difficult and complicated scientific argument to put before them. If, after the considerations which I have put before you—and which, pray be it understood, I by no means claim particularly for myself, for I presume they must be in the minds of a large number of people who have thought about this matter—if it be that these ideas commend themselves to your mature reflection, then I am perfectly certain that my appeal to you to carry them into practice, with that abundant energy and will which have led you to take a foremost part in the great social movements of our country many a time beforehand, will not be made in vain. I therefore confidently appeal to you to let those impulses once more have full sway, and not to rest until you have done something better and greater than has yet been done in this country in the direction in which we are now going. I heartily thank you for the attention which you have been kind enough to bestow upon me. The practice of public speaking is one I must soon think of leaving off, and I count it a special and peculiar honour to have had the opportunity of speaking to you on this subject to-day.

APPENDIX C C.

PAPERS RELATING TO INDUSTRIAL TECHNICAL EDUCATION IN GREAT BRITAIN AND GERMANY.

I. Introduction.

II. Miscellaneous Extracts relating to Manual Training in England, in 1897.

III. Addresses delivered on occasions of the opening of new Technical Institutions in Great Britain, in the autumn of 1897.

IV. Two papers from the New York Tribune, showing English and German estimate of the value of Technical Training.

V. Summary of Contents of English Science and Art Report. (London, 1897.)

VI. Report on Technical Education in Germany, with "Notes", by English Experts.

APPENDIX C C.

PAPERS RELATING TO INDUSTRIAL TECHNICAL EDUCATION IN GREAT BRITAIN AND GERMANY.

I.

INTRODUCTION.

The delay in the issue of Part III. in the final Appendix of which the most recent movements in the development of Technical Industrial Education in the United States, up to 1897, are recorded, has given opportunity for the publication (November 1897) of the two volumes of the Annual Report by the U. S. Commissioner of Education, for 1895–'96; as well as for the issue, in London, of the Annual Report of the Science and Art Department of Great Britain.*

Reference has already been made, in a note to the Introduction of the present volume, to the special articles, in the latest Annual Report by the U. S. Commissioner of Education, relating to Technical Education. (See Page XLVIII.)

In the present Appendix, added for this purpose, a concise summary of the general contents of the English Report is given; with, in addition, the greater part of a Special Report therein included, made by leading English Experts, upon the most recent developments of Technical Training in Germany; an important authoritative statement of the educational activity of this great industrial Empire.

Abstracts of addresses delivered by leading English Authorities on the occasions of the ceremonial openings of various new Technical Educational Institutions, during the autumn of 1897, compiled from the current reports in The Manchester Guardian, precede these extracts from the Government Official Report, just referred to.

It will be observed that all the the speakers quoted are emphatic in calling attention to the great lack of sufficient elementary education, arising from the fact that the large majority of school children do not attend school after the age of twelve years. In addition to this deficiency of elementary schooling, a large majority of the students in the great technical institutes attend only the evening classes. For example, it is stated that, of the thirteen hundred students in the Royal Technical Institute of Salford, only twenty, were day pupils.

In the two Appendices which immediately precede the present, are given extracts from official publications and reports which show the great interest that was taken by English Educators and Statesmen, in the movement for the promotion of industrial and technical Education in Great Britain, from 1884 to 1888. In the present Appendix, the similar extracts which are included show the interest

*Forty-Fourth Report of The Department of Science and Art of the Committee of Council of Education, with Appendices. London 1897, Pp. LXIV., 481.

that, a decade later, continues to be taken in these movements, by the English leaders in Education and Statesmanship, in 1897.

It is of no small significance to the people of the United States that, as the articles here collected show, the two most powerful industrial nations of Europe, Great Britain and Germany, thus continue their active efforts in promoting the Industrial, Technical and Artistic Education of their youthful population.

That other European countries were fully awake to the necessity of such definite technical training of their own people, is shown in various papers comprised in the several Appendices to the present volume of this Report.

Two papers of interest are taken from the files of the New York Tribune; one, gives a graphic account of the result of definite technical industrial training in promoting the prosperity of the well-known manufacturing town of Bradford, England; the other, is an editorial analysis of a Belgian Government Report, showing concisely the great number of Technical Industrial Schools which permeate the German Empire; prepared to drill an army of skilled operatives, no less powerful to protect the Fatherland, than are the vast armies of soldiers that obey the Kaiser's slightest whim.

In the modern world's contests of commercial competition which army is the most to be feared by rival nations?

II.

Miscellaneous Extracts Relating to Manual Training, Sloyd, etc.

The following extract from the London correspondence of The Manchester Guardian, (September 13th 1897), shows the present unsatisfactory status of this form of elementary education in the Schools of London, and the inception of a new movement looking to the immediate development on a large scale, of Manual Training in the schools of that city:

A great impetus is about to be given to manual training in connection with the Board schools of London. Before the end of December the 127 centres for such training will have grown to 150, available by nearly all the schools under the Board. At present about a third of the schools are practically unable to make use of the centres. Not merely the desire to perpetuate the supremacy of British over foreign workmen has prompted the increase; it is due partly to a conviction that children who receive manual instruction take more interest in the ordinary lessons and are generally brightened. Boys, for example, who have received instruction in carpentry draw with added zest. Moreover, manual-instruction pupils oftener remain at school till the age of 15 or 16, while the withdrawal age among the others is usually 12 or 13. In this important work the Board already employs an organiser, two assistants, and nearly 200 instructors, not one of whom is allowed to teach more than 20 pupils at once.

The following brief report of an educational meeting in the Manchester Guardian (October 18, 1897) gives a view of the interest taken by some English educators in that phase of Manual Training in wood cutting, as formulated and taught by Director Salomon, in the seminary at Nääs, Sweden, and known in England, as "Sloyd".

THE SLOYD ASSOCIATION.

At a general meeting of the Sloyd Association held on Saturday at the offices of the Teachers' Guild, in London, with the Hon. Lyulph Stanley in the chair, the proceedings were of an unusually interesting character. Sketches of various sloyd

courses held this summer were given—of that at Nääs by Mr. H. R. Reichel, principal of University College, Bangor, who for a second summer in succession had gone through a course of bench work there; of that at Ambleside, conducted by the Sheffield Manual Training School, by Mr. W. Nelson, of the London School Board, and of that at Bangor, conducted by Miss Andrén, by Mr. J. C. Hudson, of the Hornsey School Board. Mr. Reichel declared that the view which he formed, and published, of the value of the Nääs seminary had in the course of the twelve months been changed but little. A single course there for a man unaccustomed to the use of tools he now, however, thought insufficient. It might enable him to start a course of instruction, but not to continue it for a period of twelve months. For the first time since 1888 the secondary teachers from England had been as numerous as the elementary, owing to the large contingent—twelve—which he had brought with him from Welsh intermediate schools. As for the discussions for which Nääs was so famous, and for which the rainy summer there had given unusual scope, they possibly converted no one who went there opposed to the Nääs ideas, but there could be no doubt that they brought into clearer view for every teacher there the immense, the fascinating, possibilities of the teacher's career. Four days of the course the entire body of students gave up to the industrial and art exhibition at Stockholm, where there was an unusually complete exhibition of sloyd exhibits from the schools in the various provinces of Sweden. But perhaps the most interesting item in the programme was the reading of Herr Salomon's address at the Nääs jubilee this summer, a translation of which had been prepared by Mr. Reichel. It presented a graphic picture of the work pursued at Nääs.

The following local item from the Manchester Guardian (September 20th, 1897,) shows the generous provision made by that leading manufacturing city for giving to its youth, in day and evening classes, opportunities for Technical Training in a large number of industrial and artistic callings.

MUNICIPAL INSTRUCTION IN ART AND TECHNOLOGY.

The calendar and syllabus of studies of the Manchester Municipal School and the School of Art, just issued, furnish ample details of the courses of instruction in these divisions of practical education. The classes will be carried forward, during the winter sessions now opening, in eight buildings of the city and suburbs, under the supervision of over a hundred lecturers and members of the administrative staff. In the day departments the instruction is graded to enable youths of over fifteen whose education is sufficiently advanced, and who are designed for industrial occupations, to acquire a sound elementary knowledge in the theory and practice of the principles and processes connected with the mechanical, electrical, sanitary engineering, building, chemical, and the textile industries. This the directors consider should become the main department of the institution, and it is hoped that there will be a large accession of youths from fifteen to eighteen years of age, seeking to qualify themselves as captains of the industries depending upon scientific progress, so that this section may have the flourishing appearance exhibited by the corresponding divisions of the technical schools of Germany and Switzerland. The evening classes are for persons already engaged during the day in handicrafts or business who desire to supplement and develop the instruction of the day school and the experience gained in the workshop or warehouse. A third division is the department for women (for whose requirements special arrangements are made), the subjects being dressmaking, millinery, languages, and wood carving. New features of the coming session are lecture courses on advanced hygiene, gas manufacture, oils and fats, the design and manufacture of iron and steel bridges and similar structures, telegraphy (honours stage), the telephonic system of Manchester, microscopical research, microscopical technology applied to textile fibres, topography and lithography (honours stage), planing and milling machines, principles of mining, geology, physiology, general biology, botany, and physiography, practical instruction in brickwork and masonry, metal-plate work, and, at the Openshaw branch, building construction and drawing. At the Municipal School of Art, the session of which opens on the 20th inst., "the objects are to give, by a system of carefully considered and varied courses of study, with due regard to the bent and capacity of individuals, a thoroughly practical knowledge of designing, drawing, painting, and modelling, more especially in the various forms of their ornamental application in association with architecture and technical conditions of manufacture."

Free Scholarships in London.

In the London correspondence of the Manchester Guardian (August 12th, 1897) occurs this interesting item showing the educational advantages opened to the youth of that metropolis through the benevolence of former generations.

In recent years, thanks to School Board activity and the opening of free libraries, London has in the matter of education been making huge strides, and now it is clear that in one direction it has an immense advantage over other great centres of population. It is far more richly endowed with scholarships and other helps on the road from the elementary school to the University. Not all have been brought to light, but already the Technical Education Board has discovered 1,783 annual scholarships, of which 1,690 may be won by children in public elementary schools. In addition there are 400 which secure University teaching to London pupils, besides many others open, though not exclusively, to London students. Two hundred and sixty-seven scholarships at schools of art belong to London alone. Moreover, the School Board has the management of 75 recurring and 428 terminable scholarships, varying in value from £10 to £50 a year. It was to prevent confusion in the handling of all these good things that a general examining board was established last year. The advocates of popular control over education will note with pleasure that the result of the examinations is a victory for Board schools over their "Voluntary" rivals, the former winning 513 scholarships against 75 awarded to sectarian schools and 12 to secondary. The Board school candidates were six times as many as those from Voluntary schools, leaving, nevertheless, a margin to the credit of the former.

III.

Addresses Delivered on the Opening of New Technical Educational Institutions in Great Britain.

A few notices follow, giving an account of the proceedings accompanying the inauguration of new Technical Industrial Educational Institutions during the autumn of 1897, and of the annual opening of some of those previously founded; with extracts from the addresses delivered on these occasions by leading educators and statesmen, mostly taken from the current reports given in the daily issues of that leading English Journal, The Manchester Guardian. The notice first quoted below seems to describe an Institution very similar in its purposes to The Cooper Union Institute, in New York City. The merited tribute by Sir John Brunner, to our fellow-countryman, the late George Peabody, of London, adds interest to this occasion.

NEW TECHNICAL SCHOOLS FOR MIDDLEWICH.

On Saturday, at Middlewich, the foundation-stones of new technical schools and a free library were laid, in the presence of a large and influential gathering. The building, which occupies a site presented to the town by Sir John Brunner, is admirably designed, and is intended to commemorate the Diamond Jubilee. Provision is made for the teaching of chemistry, science and art subjects, shorthand, wood carving, typewriting, cookery, dressmaking, &c., while a well-apportioned library and reading-room will be provided. Sir John T. Brunner, M. P., and Mr. E. H. Moss (representative of Middlewich on the Cheshire County Council) have contributed £1,000 and £450 respectively in aid of the undertaking, and very appropriately they were called upon to perform the ceremony of laying the foundation-stones.—Mr. Henry Seddon (chairman of the Urban Council) presided. In calling upon Sir John Brunner to lay the first stone, Mr. Seddon said the present was an age of rich men, but it was also an age of philanthropists, and in the front rank he would place the member for Northwich.—After the two principal stones had been laid, the Chairman, on behalf of the town, proposed a vote of thanks to Sir John Brunner for his generosity, and presented to him a fine silver shield.—Mr. Hulme (vice chairman of the Council) seconded, and the Vicar of Middlewich supported the motion, which was cordially adopted.

Sir John Brunner, in reply, said he trusted that the work which would be carried on in the school would redound to the credit of those who had begun it.—(Applause.) The reign of Queen Victoria had been distinguished beyond all other reigns by the fact that the public conscience had been awakened, and that rich men had been stirred to bestow of their wealth for the public good. The example was set somewhat late in the Queen's reign by the American, George Peabody; but that example had been admirably and nobly followed.—(Applause.) They had heard that they ought to be proud and happy that they lived in such an age as this. They did not remember as often as they ought that within the last 25 years they had been closing prisons all over the country, and at the same time had been erecting schools. He hoped the school would have an effect upon the people of Middlewich far above the level of keeping people out of prison, and that it would raise them to the dignity of honourable and worthy citizens.—(Applause.) They all knew that in the neighbourhood there was diminished opportunity for employment, and, therefore, they would do well if they looked about for a means of making the town more attractive. In this direction, he believed the new institution would have an important influence.—(Applause.) Professor Huxley had said that probably excepting the Italian, the British intellect was the finest raw material for the teacher in the whole world. He (Sir John) had seen much of the artistic and technical work of other countries, and he was satisfied that, given the same opportunities, the Englishman would be at the head.—(Applause.)

Mr. W. Boosey, (chairman of the Technical Instruction Committee) presented to Mr. E. H. Moss, as a recognition from the inhabitants, a silver flower-bowl, and at the same time proposed a vote of thanks to him for his gift to the schools.—Mr. T. Haddon seconded, and the motion was carried.—Mr. Moss, in response, said he trusted that Middlewich would not be content with having an ornamental building, but that the people would make the fullest use of the opportunities provided for them.—(Applause.)

Subsequently some 200 guests attended a reception by Mrs. H. Seddon in the Middlewich Town Hall.

DESCRIPTION OF THE ROYAL TECHNICAL INSTITUTE OF SALFORD.

This admirably equipped Engineering Institution was opened for pupils a year ago, although, at that time, only partially equipped with the requisite mechanical appliances; nevertheless it soon had an attendance of thirteen hundred day and evening students.

The opening for the session of 1897–'98 was announced for the 22nd of September, when the Inaugural Address was to be delivered by Mr. William Mather, the gentleman who visited the United States and made the Special Report on Technical Education in America included in the great Report in five volumes on Technical Instruction issued by the English Royal Commission 1884. (See reference in Part I. of the present Report, pages ccliv-v.)

After stating that the building was opened for inspection by the public for three days, the Manchester Guardian, of September 3rd, remarks that visitors may have been surprised at the extent of the provisions made for instruction in Electrical Engineering and says:

The explanation is simple. Salford contains some of the largest electrical engineering works in the country, and the Committee hold that they have in the Institute a sort of natural centre for technical instruction in this growing branch of industry. Of the six laboratories in the physical department, four are especially arranged for the study of theoretical and practical electricity.

The dynamo-room contains a thirty-horse power nominal high-speed vertical steam engine, which drives two sets of speed cones, and from these the experimental dynamos, four in number, are driven. Two are for direct and two for alternating current work, and each dynamo is provided with its own set of instruments and artificial load. The dynamos, it should be understood, are used exclusively for experimental work. They have nothing to do with the lighting of the building. The electric light with which the whole of the Institute is provided comes from the Corporation supply. In the testroom adjacent to the dynamo-room there are two of Lord Kelvin's standard balances, a large variety of volt meters and ammeters, as well as two transformers and two motors. The electrical circuits

in this room are controlled by means of a mercury distributing switchboard. The storage-battery-room contains 32 high-discharge chloride cells and 30 smaller ones for use in the laboratories. Two of these laboratories are arranged for electrical engineering, and in connection with this department there is a photometric-room, in which provision is made for the complete testing of arc and incandescent lamps. In addition to the usual lecture-rooms and drawing offices, the mechanical engineering department has an exceedingly well-equipped machine shop, which contains three large self-acting screw-cutting lathes, and also drilling, shaping, and slotting machines. One of the new features of the department, said also to be new to the district, is the machinery for experimental work in the applied mechanics and steam and motive power laboratories. In the applied mechanics laboratory, for instance, there is a testing machine which, although specially designed for tensile stresses, can also be used to test pressure and vacuum gauges and the bursting strain of thin boilers. The laboratory also contains a cement tester, an oil tester, various lifting machines, a differential pulley block, a screw jack, and the ordinary standard measuring instruments used in engineering. In the steam and motive power laboratory the arrangements are such that students can test for themselves the action and efficiency of steam, gas, and oil engines. The engines are fitted with all necessary dynamometers, meters, and pressure gauges. In this laboratory, too, determinations of the mechanical equivalent of heat will be made. The dyeing and calico printing department has a remarkably complete equipment. The printing school is said to be the only one in the country at present with full-sized printing machinery. In the dyehouse there are three large tables, giving accommodation for upwards of thirty students. The tables are provided with steam and all the other appliances necessary to a scientific study of dyeing. The equipment of the printing-rooms includes a full-sized sample printing machine, an ageing machine, a hot-air drying and padding machine, and colour-mixing pans; together with one or two small sample printing machines, driven in all cases by means of an electric motor. Attached to the spacious laboratory in the chemistry department there is now a large balance-room, and a room specially arranged for gas analysis. There will be a course of study in the latter subject, combined with practical work during the winter. Of the other departments, which were already completely equipped at the opening of the Institute, it is unnecessary to speak. It will be sufficient to add, as an indication of the scope and diversity of the instruction, that for the coming session about 120 evening classes have been arranged in various subjects and grades of subjects.

The following account of the meeting at the Institute, and the report of the Inaugural Address by Mr. William Mather, appeared in the Manchester Guardian, of September 23rd, 1897.

TECHNICAL EDUCATION IN SALFORD—ADDRESS BY MR. WILLIAM MATHER.

There was a large gathering of the people of Salford last night at the Royal Technical Institute, Peel Park, to witness the distribution of prizes won during session 1896–7, the first session of the Institute, and to listen to the inaugural address of session 1897–8. Mr. Alderman B. Robinson, chairman of the Technical Instruction Committee of the Corporation, presided.

The Chairman, after speaking of the gratifying progress recently made in Educational matters in Salford, briefly referred to the difficulties anticipated when the Institute was opened a year ago, owing to the incomplete equipment of the Laboratories; but the unlooked for attendance of students, the growing generosity shown by citizens in contributing the means to furnish the Laboratories with requisite engines and implements, combined with the ability and zeal of Principal Wilson, and the energetic corps of teachers, had made of their first year a brilliant success.

In the Annual Report by Principal Wilson, the difficulties thus surmounted were described somewhat in detail. In regard to the matter of attendance, which is similarly commented on, it will be noticed, by most of the authorities quoted in the present appendix, he spoke as follows:

The great difficulty they had to contend with, a difficulty which was not peculiar to that district, was that parents did not realise the absolute necessity of giving their children from fourteen to sixteen years of age the benefit of a two years' training

such as could be obtained at the Institute. He hoped the time was not far distant when it would be essential for a lad, before he began his apprenticeship, to produce evidence that he had had such a training. It was a very lamentable circumstance that our large technical schools, which were being raised and equipped throughout the country at so great a cost, had comparatively little teaching work to do during the day. Fortunately, however, most of the institutions were crowded in the evenings, and although nothing could equal a course of day study, yet it was satisfactory that the evening classes were so well attended. It was matter for congratulation that many of the firms in the borough were practically compelling, or at least bringing great pressure to bear on, their apprentices to attend the Institute for three or four nights per week. If that became general, the result, he felt sure, would be satisfactory to all concerned.—(Hear, hear.) As to the results of the past year, the students of the art department were specially to be congratulated on the very high standard of excellence which they had set up for themselves and future art students of the Institute.

With a statement of the very creditable results as shown in the number of prizes won by the students of the Institute in the National Competition, and with details of the results of the examinations in Science, Technology, and Art, the Principal closed his Report.

The address by Mr. Mather, follows as reported.

Mr. William Mather, was received with cheers on rising to deliver the inaugural address for the coming session. He said that since the Technical Instruction Act was passed in 1889, about one million sterling had been spent by county councils, county. boroughs, and municipal bodies on institutions for technical instruction. Salford had bestowed on its institute about one-twelfth of the total expenditure of the country for this purpose. From being unenviably distinguished for its inadequate provision to secure the proper training of the youth of the town beyond the elementary school stage, it had suddenly risen to a distinguished position in having provided one of the largest institutions for secondary and technical education in the whole country.—(Cheers.) In order to accomplish this, the Salford Corporation had done some bold things; perhaps it might be said their newborn zeal had overrun their discretion. They had spent the whole of the annual grant received from the national exchequer under the Act of Parliament of 1890, which bestows on cities and towns, in proportion to the population, a part of the £780,000 derived from a tax on whisky and beer. The Corporation had the right to use the money accruing to them from this source, about £4,000 a year, for the relief of rates, but they resolved to build that school, borrowing a lump sum which the annual grant would repay, with interest, in thirty or forty years. Moreover, they had levied a rate of 1d. in the pound on the ratepayers—permitted by the Technical Instruction Act of 1889,—and this also they had absorbed for the purpose of maintaining the Institute, making £80,000 in all. And he might remind the Corporation that, having put their hands to the plow, they could not turn back. They would have to find efficient means to work the school well.—(Hear, hear.) The equipment for the various branches of technical training undertaken at the school was excellent, practical in design and construction, and sufficient for present purposes. The curriculum he considered in all respects admirable. It reflected great credit on the principal, Mr. Wilson, and his colleagues. They had selected most wisely a few subjects of first importance in the district—namely, mechanical and electrical engineering in all branches, with technological instruction of a very practical sort; chemistry and chemical processes (especially those applicable to textile trades), spinning and weaving, building construction and plumbing work, domestic work, cooking, and millinery. The fine art subjects were drawing, painting, decoration, art design, and modelling. If all these subjects had proper attention, they were sufficient in number for any high-class technical school.

IMPORTANCE TO THE STUDENT OF THOROUGHNESS

The professors and teachers, judging from the curricula drawn up for the several courses of instruction, meant thoroughness, not moving on until you had made sure of the ground. It was infinitely more important for a student to take two or three years to the first part of a course which was expected to take only one year, in order to get that well into his brain, than to hurry through the whole course in three years, relying only on memory to get through his examinations, if he did not possess the natural ability to assimilate quickly the knowledge presented to his understanding. The main object in teaching the young must be to make sure that knowledge was their own; it must get into the blood and bone, so to speak, and

become an integral part of their being, not a garment put on that would wear out.—(Hear, hear.) As to the result of the first session's work, the first fruits of the seed of technical knowledge sown in that place, it would be unfair to make comparisons, or to expect from a first session in a new school, with students new to their work, results equal to those achieved by other schools of long standing. Suffice it to say that on the opening of the Institute last September there appeared to have been a rush of evening students and a sprinkling of day students. In all 1,240 enrolled, of whom 1,119 were evening students. Some of the seed of scientific knowledge seemed to have fallen on minds ill-prepared for it, like rocky ground with no sustaining quality, and under temptation the students fell away; some fell on minds filled with love of pastimes and sports, and the pleasures of this life, which choked the seed, and it yielded no fruit; but some fell on good and honest minds, who once having received the seed had kept it, and were prepared to bring forth fruit with patience. The latter quality characterised the majority.—(Cheers.) He was glad to see a strong contingent of students in the engineering courses and in chemistry; these subjects formed the basis of all scientific industry, and promoted accurate thinking and working, apart from the direct use of the knowledge in trade.

A GREAT OPPORTUNITY OFFERED TO THE YOUTH OF SALFORD.

He thought that this being a special occasion he might venture to make an appeal to the youth of Salford and their parents to regard the opening of the Salford Technical School as one of the greatest opportunities they would ever have bestowed upon them for promoting their success in life. He asked every boy and girl who was about to pass out of the elementary schools what were they going to do with the precious years between school age and manhood or womanhood to continue the education only begun in the elementary schools. He warned them that in the course of their life they would find themselves most heavily weighted in the race of life if they did not now take the trouble to make the best of the opportunity presented by that school to train their faculties for the work lying before them.—(Hear, hear.) Every boy and girl in Salford in good health, if they intended or desired to prepare for their future well-being, should spend at least three evenings each week during the school session in continuing the education begun in the elementary schools, either in the continuation schools or in that Institute. He might tell them that the boys and girls in many other countries were trained to regard the cultivation of their faculties as the only means of success in life, and far more years were given to education before beginning work than was customary in England.

ENGLAND ESSENTIALLY A MANUFACTURING COUNTRY.

We must not forget that the population of this country could not live without exchanging the work of our hands and the thought of our brains with those of other nations. We enriched this country in the degree in which our knowledge and work were equal or superior to that of other countries. If we remained in ignorance, or they surpassed us in intelligence, we should become poor and incapable in comparison with them. It was this great fact that in recent years had caused the education of our working classes, and the better education of all classes, to be the one great hope upon which this country must depend for the continuance of its prosperous existence. In that Institute they would be shown the way to acquire and use scientific truths in the arts and crafts in which they would be engaged as producers, distinguishing their labour from drudgery and rendering it more valuable, for the skilful hand would have behind it the cultured mind. Of all dangers, let them avoid the temptation of assuming that, with a technical training, they had become superior to practical work, and were straightway fitted to take places in manufactories or workshops to direct others who did the manual work.—(Hear, hear.) Such an idea would constitute a student a technical prig, and he would be cast on the scrap heap of failures in the real work of life. No; their training there must prepare them to enter into the real work of producing by their own hands with greater zest than an ignorant man could possibly feel, and not put them above it. If they became intelligent workmen by reason of their training there, and showed superiority to other intelligent workmen by reason of more ability or qualities of character, they would rise in the ranks of industry to the places they could most profitably fill for their employers and themselves. The man whom "knowledge puffeth up" was more ignorant than the man who, knowing little, put into his work all he knew.

Let all their studies and work in that school be thorough. Never advance a step until they had thoroughly made their own for ever the ground on which they stood. Let them discard the ambition to qualify with feverish haste for an examination.

They must come there to be trained in the art of doing things from knowledge, and that would enable them to do them well. When they left that place and faced the duty of performing industrial work, they must show that they could do it with greater skill and aptitude than the youth or man who had not taken the trouble to train himself as they had done.—(Hear, hear.) In conclusion he appealed to the parents in Salford to consider very seriously how they could manage to keep their sons at least a year longer from working for a living, in order to pass some time as day students in that school. Even those parents in Salford who could well afford to extend the time of education for their children might fill that school now with 400 or 500 day students (alas! they had only twenty).

IMPORTANCE OF DAY SCHOOLING.

If the many technical schools spreading over the land were to produce an effect soon on our industrial and commercial life as a nation, we must have them filled with day students.—(Hear, hear.) Had that splendid school been erected in a Swiss, German, or American town of the size of Salford, it would be filled with well-prepared day students in two or three years. He hoped parents, teachers, School Board, and employers of labour would do their duty in relation to that Institute, so that we might see such a result in Salford. He was bound to say that the municipal authorities, of whom he might be pardoned for mentioning Mr. Alderman Robinson with special acknowledgment of his great services—(cheers),—had given full measure of opportunity, pressed down and running over, to all those who had special responsibilities in regard to the promotion of higher education in that town.—(Cheers.)

The prizes won during the past year were distributed by Miss Mather.

On the motion of the Mayor (Sir Richard Mottram), seconded by Mr. Platt-Higgins, M.P., a hearty vote of thanks was accorded to Mr. Mather and Miss Mather.

The proceedings closed with a vote of thanks to Mr. Alderman B. Robinson for presiding and for his work for the Institute, accorded on the motion of Sir William Bailey, seconded by Mr. Lees Knowles, M.P.

A few days after the delivery of his address at Salford just quoted The Manchester Guardian (October 7th 1897) reports another address by Mr. Mather on a similar occasion at the anniversary of a Technical School at Stockport. As this address is largely given to a statement of the educational conditions in this country it is here inserted in full.

MR. WILLIAM MATHER ON TECHNICAL EDUCATION—THE EXAMPLE OF AMERICA.

The annual distribution of prizes to students at the Stockport Technical School was made last evening by Mr. William Mather, in presence of a large gathering of friends of the institution. Mr. F. R. Robinson was in the chair, and amongst those by whom he was supported were Sir Joseph Leigh and Mr. S. Kay. The report of the Principal of the School (Mr. R. J. Brown) showed that during the past year there had been in all 1,389 students, compared with 1,337 in the previous session. Many of these, it was stated, came from beyond the boundaries of the borough, and regret was expressed that in consequence of no grant being received from the Lancashire County Council higher fees had now to be charged to students who came from neighbouring parts of Lancashire.—The Chairman in the course of his address mentioned that the school was doing its work without costing the ratepayers a penny. He thought, having regard to the expenditure on technical education on the Continent, they did not spend money on that object in Stockport in the proportion they ought to do. He considered also that their own manufacturers gave too little attention to the school.—(Hear, hear.)

Mr. Mather, in his address before distributing the prizes, said with regard to the complaint that no contribution was received from the Lancashire County Council, that was the penalty of the geographical position Stockport occupied. He could not follow the chairman in regarding it as a matter of congratulation that they had not levied a penny rate. He regarded that as one of the honours they still had to achieve. He could assure them that they would not be level with the towns that went heart and soul into the matter of technical education till they had levied the penny rate and expended it in the furtherance of that object.—(Hear, hear.) Parliament had made up for lost time in affording facilities to the whole nation for giving technical instruction and training. But the country unfortunately

could not profit from it for some years in the sense in which America, Germany, Switzerland, and even France were benefiting from their technical schools. One reason for this difference was that contained in their report, where they said they had to provide a preparatory course of instruction for many students owing to inadequate education in the elementary schools, or the neglect of parents to keep their children at school to acquire the necessary education in the higher standards. This illustrated the baneful conditions prevailing throughout the country, and until these were radically changed, technical school teachers and managers would be working in a wilderness. The Manchester Technical Instruction Committee reported to the City Council a year or two ago that only 9 per cent of the pupils enrolled in the public elementary schools were over 12 years of age. We were competing with Continental towns, where the whole of the children continued at school beyond the age of 12, and a large proportion up to 15 and 16. There was no blame attached to the Manchester school system. So far as the education went, taking into account the age at which the pupils were taken from school, it compared favourably with that given on the Continent. Our technical schools differed from those of other nations from their adaptation to evening students, who went to them in order to make up for lost time or imperfect education at the ordinary schools. For the sake of the future, it must be asked whether the character of our technical instruction was to remain as it is, and whether the schools are to be chiefly utilised for evening students. Could our industrial classes retain their pre-eminence, or even their share of the world's custom, by depending on our present system—the short life in elementary schools; evening schools not compulsory, and as yet few; organised science and art and technical schools, which were almost all employed for evening students? His answer to all these questions was most decidedly in the negative.—(Hear, hear.)

Let them look for a moment at other nations. America, Switzerland, Germany, and France had virtually all their children of the industrial classes in school at 14 years of age, whereas in that centre of trade and commerce, the city of Manchester, we had not more than 10 per cent of the whole school children beyond the age of 12.

ADVANTAGE OF THE LONGER ELEMENTARY TRAINING OF AMERICAN YOUTH.

In America—a country he dreaded more than all the countries of Europe put together as our future rivals—the school age of the children was from 5 to 16, 17, and 18 years, varying in the different States. There was a carefully organised system of continued education throughout those States. Using the emblematic stars of the American flag, as representing the States, he might say that one star differed from another in glory as regarded education, for the States did not shine all alike, in the brightness and intelligence of the population, but the widespread provision for the free education of the masses, from the primary schools, corresponding to our elementary, on to the grammar schools, and up to the high schools corresponding to our best grammar schools. In addition, there was a State College in every State, and it was said that not less than 100 colleges and universities in the United States were offering technical instruction to day students throughout the year. Some were institutions of long standing and high repute, which were rapidly transforming themselves to meet the needs of the age, without necessarily abandoning their functions as classical schools. Apart from these, schools of technology were provided by the liberality of citizens in the great cities of the longer-settled States. Throughout the States plenty of opportunity was afforded for the technical education of the young population before they entered on commercial life. All these institutions were filled with day students. He wanted to make clear the distinction as to the results between day and evening students. In America a vast army was being created, and continually recruited, of young men—and women too—who possessed a store of knowledge, and were made practical by the acquired art of applying their knowledge owing to the technical training received side by side with scientific instruction in schools filled regularly with day students. The great technical school of Boston, with 1,200 day students, passing through a two or three years' course, afforded them an example and a warning. Many of the railway companies' works and great manufacturing establishments eagerly sought young men from this school. He was told by the manager of one of the greatest of the railway workshops in the United States that they would not employ a young man under 21 as a learner or improver unless he had gone through the Boston or a similar school. Could they wonder that in engineering or mechanical pursuits the Americans were showing signs of successful competition with ourselves, even in our own country? They had manifold disadvantages. They had not the same experience in the development of natural resources as ourselves; they had much greater difficulties in connection with the cost of labour; but, notwithstanding this, they had achieved results which were threatening us with very serious rivalry.

EDUCATION OF THE PEOPLE IN SWITZERLAND AND GERMANY.

What had the little State of Switzerland done? There a perfect system of day schools culminated in technical schools and universities, provided for every Swiss youth practically free, and heavy taxation was cheerfully submitted to by the whole people to maintain them. Taking Germany as perhaps the best example of systematical training, Mr. Mather pointed out the sacrifices the people had made there in the way of heavy taxation and of withholding their children from work at an early age in order that they might be well instructed. He was sent in his youth to Germany to profit by the technical education offered there, and he sat with scholars who were the children of working tailors and mechanics, whom he liked for their manners and attainments, and visited at their homes, and in many of these cases the parents did not earn on an average more than £1 per week, but made sacrifices that their sons might rise in life, very often to their advantage by their sons' success in afterlife.

DEFICIENCIES IN ENGLISH EDUCATION.

In this country the State and private liberality had provided the means of technical instruction, and school authorities were devoted to their work, but two things were wanting. One was about to be supplied by a scheme of secondary education, but they would still lack that which alone could give life and spirit to the system. Upon whom rested the responsibility of infusing the life and spirit required? He answered, upon the parents, and in some degree upon the employers of the young. Parents must be determined to keep their children to the full age at the elementary schools, pursuing their education through all the standards. After that stage was passed, all who could afford by making a sacrifice—a great boon to their children—should send them for two or three years to one of the higher grade, the secondary, or the technical schools which were now so widespread and convenient in all our towns, and which, under the promised system of secondary education, would be thoroughly co-ordinated. (Applause.)

Mr. Mather afterwards distributed the prizes, and received a cordial vote of thanks.

The following summary of an interesting address on Technical Education by Sir John Lubbock, is from the Manchester Guardian of October 23rd, 1897. The distinctions drawn between Manual Training and Technical Instruction are worthy of note.

SIR JOHN LUBBOCK, M. P., AT STALYBRIDGE—ADDRESS ON TECHNICAL EDUCATION.

The Right Hon. Sir John Lubbock, Bart., M. P., last night distributed the prizes and certificates to the students at the Stalybridge Technical School. Mr. J. F. Cheetham presided, and amongst other on the platform were Mr. F. Platt-Higgins, M. P., and Professor Boyd Dawkins. A report on the work of the school for the past year was read by the secretary, Mr. J. H. Hyde.

Sir John Lubbock, who was received with cheers, said it was one of the pleasant privileges of a member of Parliament, and especially of a University member, to attend on such occasions to distribute the prizes and congratulate the successful candidates. Indeed he might congratulate them all, so long as they had done their best. It is not always those who were the ablest who won the prizes at school. The Duke of Wellington, Napoleon Bonaparte, Sir Walter Scott, and many other great men were said to have been dull boys. Strong trees grew slowly. He trusted that the students at that school, whether successful or unsuccessful, had received what might be called an all-round education, for a merely literary education was a one-sided education.

There were no greater mistakes as regards education than to suppose that it was a mere matter of books, and that it was to be confined to childhood, or, at least, to youth. On the contrary, what we learned from books was by no means, or at any rate ought to be by no means, the most valuable part of what we learnt at school; education, for good or for evil, went on through life.—(Hear, hear.) "I know no wiser or more felicitous description of the true aim of a school," said Sir Joshua Fitch, "than is contained in the words of President Adams, of Cornell University, when he says, 'the main object of education is not merely the acquisition of information; it is not even the development of the faculties; it is, or ought to be, the awakening of certain desires that will serve to the pupil as a sort of perpetual inspiration through life.'" Nor should education be limited to mental training. The soul was of couse the noblest part of man, but no doubt, in the present condi-

tions of our existence at any rate, it could not act except through and by the body. There were many questions which books could not solve. The Greeks tried to settle many questions by verbal arguments, which could in reality be determined by observation only. There was an essay in Plutarch's works on the question "Which was first, the bird or the egg," and one reason given for deciding that the hen preceded the egg was that everybody called it a "hen's egg," and no one spoke of an "egg's hen."—(Laughter.) We were not ourselves by any means free from the same error. Such schools as that were a practical protest against any such error. But, besides the advantage to the individual students, we hoped and believed that these technical schools would tend to develop and promote the commerce, and especially the manufactures of the country. He feared that at the present time the staple industries of the country were by no means in the condition we could wish, although he was not disposed to take a gloomy view of the country in that respect. We heard a great deal about things being "made in Germany," but, after all, our share of the commerce of the world was far larger per head than that of any other country.

GREAT BRITAIN'S SHARE IN THE TRADE AND COMMERCE OF THE WORLD.

In the last report of the United States Government it was shown that the trade and commerce of Great Britain was £700,000,000 a year, out of a total of £3,300,000,000, so that, while our population was less than one-fiftieth of that of the whole world, our trade and commerce was more than one-fifth of that of the whole world. But, while not disposed to take a gloomy view of the future, it would be necessary for us to be careful. We could not afford to throw away any of our opportunities, and he was firmly persuaded that technical schools would be very useful in enabling us to maintain the proud position we at present occupied.

"To their technical schools," said Sir Philip Magnus, "the Germans rightly ascribe, to a great extent, their industrial success. and they point with pride and satisfaction to the fact that they have weighed their knowledge and their technical training against our material advantages in mineral wealth, and have not found them wanting." At the same time we must not undervalue what had been done. The Technical Instruction Commissioners told us that the classes in connection with South Kensington "cover a wider area of elementary, and what may be distinguished as lower secondary scientific and technical instruction in this than in any other country;" and they added what, as a Londoner, he read with pride:—"No organisation like that of the City and Guilds of London Technical Institute exists in any continental country, and the absence of such organisation has been lamented by many competent persons with whom we came in contact.

EDUCATIONAL IMPORTANCE OF MANUAL TRAINING.

He (Sir John) was not one of those who thought that the training to be acquired in a technical school could be any substitute for that of the workshop. It could not replace, but it might supplement.—(Hear, hear.) There were some things indeed which could be learnt better and more quickly in the technical school. High authorities had expressed the opinion that in a fortnight of systematic school instruction a man would learn in some things as much as he could from two years in a workshop. But we would not derive from it half the advantage which was possible, unless the Code was modified so as to permit and encourage the manual instruction in our elementary schools. At present they might have, and he doubted not they had, object-lessons and Kindergarten, or some similar exercises in their infant schools, and they had now established these technical schools for young men. But for the boys between these two ages there were no corresponding opportunities; we provided for them no training in the use of the hand, in the command of the hand and eye. With girls we carried on training by means of needlework. But while we all saw the necessity of needlework for girls, we entirely overlooked the equal or even greater necessity for hand training in the case of boys. Manual training should, in fact, begin in the infant school, and continue through the school career. He would not, indeed, except perhaps in some exceptional cases, advocate the introduction of technical instruction into boys' schools. We must always remember that manual instruction and technical instruction were two very different things. In manual instruction the workshop was part of the school, and the object was not to make a workman, but to train a man; in technical instruction the school was subordinate to the workshop, and the primary object was to fit the student for some definite trade or career. But if technical instruction would be out of place in schools for boys, manual instruction, on the contrary, even for boys who might not be designed for artisans or for manufacturers but might be intended for sedentary pursuits, was a most valuable training.—(Hear, hear.)

"The boy," said Mr. Ham, "who begins to construct things is compelled at once to begin to think, deliberate, reason, and conclude. As he proceeds he is brought into contact with powerful natural forces. If he would control, direct, and apply these forces, he must first master the laws by which they are governed; he must investigate the causes of the phenomena of matter; and it will be strange if from this he is not led also to a study of the phenomena of mind."—(Applause.) Moreover, the introduction of manual training into our schools would be most important, not merely from the advantage to health, not merely from the greater command over the hand and eye which it would bestow, but also from its effect on the mind itself. The disastrous result of the neglect of manual instruction in our schools was that it tended to unfit boys and give them a distaste for manual labour. Manual instruction was valuable in all schools. It was good for the bookish boy to draw him away from his books; but, most of all, it was good for the non-bookish boy, in showing him that there was something that he could do well. The boy utterly unable, even if he were studying, to keep up in knowledge and percentage with the brighter boys became discouraged, dull, and moody. Let him go to the workroom for an hour and find that he can make a box or plane a rough piece of board as well as the brighter scholar—nay, very likely better than his brighter neighbour,—and you had given him an impulse of self-respect that was of untold benefit to him when he went back to his studies. He would be a brighter and a better boy for finding out something that he could do well.—(Applause.) In his further remarks Sir John Lubbock spoke of the wonderful fascination of machinery, and pointed out that the mechanical improvements of the century had been brought about in no small degree by men of poor and lowly origin. Even now, he said, there was no single substance in nature the properties of which were fully known to us. What we had discovered was but an infinitesimal fraction of the revelations that remained for the patient student. No one could doubt that discoveries as great as any of the past still awaited us in the future. Perhaps within those very walls, by some of their own students, new steps would be taken in the triumphal progress of science, new discoveries made, which would contribute to the advance and welfare of mankind.—(Applause.)

On the motion of Mr. F. Platt-Higgins, M.P., seconded by Mr. Alderman Ridyard, thanks were accorded to Sir John Lubbock for his address.

The following address by Sir. William H. Bailey, given at the prize distribution of the Hindley Technical Schools, gives a striking picture of the wonderful industrial development of England during the reign of Queen Victoria—due, largely, to the inventive genius of a few humble natives of Lancashire.

[Manchester Guardian, October 21st, 1897.]

SIR. WILLIAM H. BAILEY, ON TECHNICAL EDUCATION AND FOREIGN COMPETITION.

At the Hindley Technical Schools last night, Sir. William H. Bailey, in presenting prizes to the successful students, spoke of this Diamond Jubilee year of the Queen as a season of contrasts and measurements of national progress. The pious Scotch elder, who did not dare to practise self-examination as the first of Christian duties, because it made him too proud, must only be imitated by those who cared not for our future commercial prosperity, for those who knew, as he did, anything of the work done in other countries—those who have studied the progress and skill in the first principles of the arts of industry and in the scientific use of force by our competitors abroad—knew very much that should discount our pride and vanity, and make us feel anxious about our future commercial prosperity.

Until recently technical education has been much ignored, if not entirely neglected, in England. If, since the days of Elizabeth, half as much of the goodness and public piety and thought and work that has been given to the care of the poor, and in the distribution of parish doles, had been devoted to the prevention of ignorance, those monuments of woe and past neglect, which are often the largest buildings in our towns—the workhouses—would have long since ceased to exist.—(Applause). Friends of education felt that now, amongst the great triumphs of the age of Victoria, we might count free libraries, Board schools, and the technical colleges and institutions of this country. Might he ask technical students to remember this—that, having mastered the first principles of their work, having in their memories the rigid logic of the multiplication table and the two-foot rule, and having by practice in drawing made the fingers the willing and obedient servants of the eyes and the brain, they should then let the recreations of their leisure be the historical development of the subject of their studies.—(Hear, hear.) What was this history but the fascinating dramatic record of methods of work, of the successes and the fighting,

struggling, and often failures of the friends and benefactors of the human race? Sir William went on to speak of the remarkable scientific and industrial developments of the Victorian era, and said technical education and foreign competition were receiving serious attention by all thoughtful men, and it might not be out of place to trace some of the causes which had greatly created the commercial supremacy of Lancashire.

DEBT OWED BY MODERN CIVILIZATION TO A FEW HUMBLE INVENTORS.

We owed all to the inventive skill and natural ability of the men within a few miles of this immediate district. Kay, of Bury, invented the fly-shuttle; Tom Hayes, of Leigh, invented the art of spinning by rollers; Hargreaves, of Blackburn, invented the spinning-jenny; and Crompton, of Bolton, the mule; Radcliffe, of Stockport, improved the steam loom; and Richard Roberts, of Manchester, invented the self-acting mule. Their improved methods of spinning and weaving increased the producing power of the works in this district far more than 50 times, and it was useful for us to remember that, before the year 1733, when Kay's invention was introduced, we were not superior to the natives of the Pacific Islands nor the pigmies of Central Africa in our methods of spinning and weaving. The robes of the Queen of Sheba, the vestments of the Cavaliers, and, indeed, the garments of George II., were produced by methods of spinning and weaving as primitive and differing little from each other, and our great superiority commenced only when Kay introduced his fly-shuttle, two pickers and a bit of string. He found that even up to 1803 we bought yarn from India, and it was only about 75 years before this that we began to cast our own iron hollow-ware, most of it having come from Holland and Germany. We imported Dutchmen at the beginning of the last century to teach us how to make pumps, bleachers to show us how to bleach, and for a thousand years before the end of last century the cottonopolis of Europe was Barcelona. If it had not been for our cheaper production, because of our mechanical inventions, it might still be 'cottonopolis.

VALUE OF DEFINITE INDUSTRIAL TRAINING STATED TWO CENTURIES AGO, BY AN ENGLISH AUTHOR.

He bought a note-book the other day, published in 1676; it was the first cry for technical education in this country. Its title was "How to outdo the Dutch without fighting," and it was written by Andrew Yarranton. The old author said that "inasmuch as we cannot fight on the seas, as our boats are inferior to those of the Dutch, if we are to exist at all, we must sharpen the wits of our people," and he pointed out that mechanics' universities had existed for many years in Germany and Holland, and we should send there for teachers. He proceeded:—"Get a man from Freiburg to put us in the way of making tapes, and to bring over two engines, one for narrow and one for broad tapes, with wheels to spin. Send for one man to Dort, in Holland, to put us into the way of treating the fine threads, and for a spinning mistress from Germany to govern the little maids, and instruct them in the art of spinning; for a man from Haarlem, in Holland, to whiten your tapes and threads;" and—here comes a compliment to Manchester—"if you do this you will become masters of it, as Manchester is in all things it trades in." He stated these facts to show how comparatively recent had been British commercial success in manufacturing. Up to the beginning of last century nearly all our cast-iron pans came from Holland, but since then nearly all iron manufacture in this country, and the improvements generally up to a recent period had been English. Let them not forget that the first iron boat was made near Ulverston, in this county, by Wilkinson. We owed our great success chiefly to the singular natural ability of our inventors, most of whom had scanty education, but great imagination. But the inventors of the present day must be scholars and educated men. Our mechanical appliances and improved processes invented by Englishmen in the middle of the last century caused us to be superior to our trade rivals abroad, and we must not be astonished when we were told—what he knew to be true—that in America, in Germany, and in France many improved methods were being discovered, which, in some cases, were very superior to ours. The factory system that had been so successful in textile manufactures was being introduced into the production of machinery, and the hand lathe and the common drilling machine would shortly be ancient tools, only fit for the jobbing smith. It was for our manufacturers and captains of industry carefully to study the new movement, in order that we might retain and strengthen those manufactures which were being assailed. He had great confidence in the future if the technical schools were managed with the energy displayed at Hindley, and other technical schools in the manufacturing districts of Lancashire.

Students must not forget that education was merely the accumulations of stores. Education was only the bricks and mortar. Ideas depend upon the initiative skill of the scholar, on his imagination and constructive power, and his ability to utilise the materials accumulated.—(Applause.)

The following suggestive address by the Duke of Devonshire, was delivered on the occasion of the opening of a new Technical College in Darlington.

The problem of the education of a whole people is the theme of his discourse. Some of the obstacles met with, in the endeavour to promote this education, under a popular Representative Government, relying largely on local effort, are contrasted with the facilities incident to such efforts under a despotic Bureaucratic form of Government.

In common with many of the speakers previously quoted, the Duke, deplores the absence of sufficient schooling between the elementary schools and the Technical Training Classes and Institutions.

[Reported in Manchester Guardian October 9th, 1897.]

THE DUKE OF DEVONSHIRE ON EDUCATIONAL QUESTIONS.—OPENING OF DARLINGTON TECHNICAL COLLEGE.

[From our own reporter.]

DARLINGTON, FRIDAY NIGHT.

A fine new Technical College was opened here this afternoon by his Grace the Duke of Devonshire. The new building, which stands in Northgate, one of the leading thoroughfares of the town—not far from the historic house associated with the names of George Stephenson and the late Edward Pease,—has been erected at a cost of about £13,000, the bulk of which sum has been already obtained from public and private sources. The classes which have been started have attracted some five hundred students, who have hitherto had to content themselves with such educational facilities as were to be found in various classrooms in the town; and as the college is the only one of its kind within a considerable radius, it is expected that it will receive large numbers of students from Middlesbrough, Stockton, the Hartlepools, and South Durham and North Yorkshire generally.

Crowds of people gathered in the streets to witness the arrival of the Duke of Devonshire, who was received by the Mayor of Darlington (Mr. George Marshall), and who formally opened the college gates with a silver key. The invited guests, to the number of some hundreds, proceeded to the Art Room of the College, where an inaugural meeting was held, under the presidency of the Mayor, who was supported on the platform by the leading men of Darlington and other neighbouring towns. The Mayor, in his opening observations, spoke of the importance of the event to the town and district, and gave a cordial welcome to the Duke of Devonshire, who, he said, had from the first closely identified himself with the technical education movement in this country, and at the present time occupied the high position of Lord President of the Council of Education.

ADDRESS ON IMPORTANCE OF EDUCATION IN SCIENCE.

The Duke of Devonshire, who was cheered on rising, said he had had very great pleasure in accepting the invitation to come and open the building in which they were assembled, because he believed that the work of which it formed a part was not only of local but of the greatest national importance.—(Hear, hear.) Such provision as they had now made for technical education was much needed, and he believed that in erecting that building they had not only acted wisely in their own interest and in that of the generations which were to succeed them, but that they had done little more than fulfil what under present circumstances had become almost an imperative duty.—(Hear, hear.) He was aware that they were assembled in a part of the building which was mainly devoted to the purposes of art instruction, and he did not deny that art instruction was at least as essential to a very large proportion of our manufacturing and industrial interests as science itself. But he had always believed—whether accurately or not—that in the industries with which Darlington was specially identified, the mining, the iron, and the steel industries, science perhaps held a larger part than art, and for that reason he

would confine his remarks almost exclusively to the question of improved scientific education.

A few days ago there was reported in the newspapers a speech delivered by a very distinguished professor, and teacher of the Dublin University, Dr. Mahaffy, who, departing from the usual custom in connection with prize distributions, instead of taking an optimist view of his surroundings, thought fit to take a very despondent view of the education question. He said he doubted whether as a result of the education movement of the last thirty years the people of this country were either happier or better. He admitted that there might be less misery and squalor among the people, but the people were more discontented. And as to the morality which had been produced by the education of thirty years, Dr. Mahaffy said he had himself been acquainted in his professional labours in Trinity College, Dublin, with a considerable number of men who had since turned out to be remarkable criminals who had invariably been distinguished by their proficiency in intellectual attainments.—(Laughter.) He had very little doubt that the report of the speech to which he was referring was so abbreviated as to convey a very imperfect account of Dr. Mahaffy's views. As it was reported the speech was certainly calculated to convey the idea that education altogether was a mistake, and that we were better when, thirty years ago, we paid very little attention indeed to the education of the people. He did not think that that could have been Dr. Mahaffy's intention; probably he only desired to express in somewhat strong terms his conviction that much of the educational effort of the last thirty years had been carried on upon wrong principles and been devoted to wrong objects. If that was so, he did not know whether they need altogether differ from Dr. Mahaffy, for those of them who had been prominent in the cause of technical education had been not only seeking to extend the area of education but in many respects to alter its direction and to give to it a more practical character and one which they thought might be of more advantage to the people of this country.—(Hear, hear.) But if there were any who desired, as Dr. Mahaffy might have been supposed to desire, to check the progress of education of some sort in this country, their hopes and anticipations were doomed to disappointment.—(Applause.) The people of this country had now discovered that they possessed intellects—intellects which were capable of cultivation to the highest extent, even by those who were engaged in daily manual labour. And the people, having the power to decide, were not likely to relapse or allow their descendants to relapse into that condition of ignorance, whether contented or otherwise, which existed thirty years ago.—(Hear, hear.) It was not at present necessary to discuss with Dr. Mahaffy the abstract question of whether education had led to the happiness or the greater morality of the people. There was something which was to be considered even before the attempt to make the people happier or better, and that was the question of the continued existence of the people.—(Hear, hear.) And the case for technical education and the improvement of technical education was that, in the judgment of its advocates, it was essential to the continued efficiency of our manufacturing and commercial industries, but for the prosperity of which the people of this country could not continue to prosper or even to exist.

WORLD COMPETITION IN INDUSTRIAL PRODUCTION.

This was not a matter of mere theoretical speculation, but a matter of practical importance. It would be remembered that last year, or the year before that, there was a great deal of discussion on the subject of the intense competition to which some of our principal industries were at present exposed; a great deal was said about the decline and probable fall of British industry. Statistics were produced showing the extent to which, in certain industries, British manufactures had been supplanted by those of Germany and of the United States. In all those discussions Germany was the chief object of terror that was held up. "Made in Germany" became a sort of watchword and battle-cry, with which it was sought to lead us to the abandonment of old policies and to the adoption of new financial and commercial systems. Much discussion naturally followed the publication of those statements, and he thought the discussion had shown that the alarm which was created was in a great degree exaggerated, and certainly premature. The discussion showed that although comparisons between certain years and between certain branches of industry might show depressing results, much of the apparent depression was due rather to a change in the direction of our industries and in the course of trade. It was shown that the volume of our production had not diminished, that, on the contrary, it had continued to increase, although it might be true that some of our competitors had increased their trade in a larger proportion. But although the scare was, to a great extent, exaggerated, he did not think anyone would suggest that it

was altogether without foundation, or that the condition of some of our industries was not such as to require close examination, probably some caution, and certainly considerable energy, if such industries were to be retained in their present positions.

GREAT BRITAIN STILL IN THE LEAD.

This, of course, was a great subject which it was impossible for him to discuss fully on such an occasion, but he would like to quote one of the conclusions set out in an official document published by the Board of Trade after the discussions of which he had spoken:—"We are still greatly ahead of either country (Germany or the United States) in our power of manufacture for export, so much so that up to the present the gains of either in this respect have had no serious effect upon our trade; but, beginning from a lower level, each country is for the moment travelling upwards more rapidly than we are, who occupy a much higher eminence. If peace is maintained both Germany and the United States, and to some extent France also, are certain to increase their rate of upward movement. Their competition with us in neutral markets, and even in our home markets, will probably, unless we ourselves are active, become increasingly serious. Every year will add to their acquired capital, and they will have larger and larger additions to their population to draw upon. It is necessary, therefore, more than ever that attention should be given in the United Kingdom to the business of manufacturing for export. It is a mistake to suppose that the increase of wealth in foreign countries is, on the whole, unfavourable to us. The richer neighbouring nations are the better for us and for the rest of the world in the long run. But the change of conditions must be recognised, and we can scarcely expect to maintain our past undoubted pre-eminence, at any rate without strenuous effort and careful and energetic improvement in method."—(Applause.)

That was from a document prepared, no doubt, with the honest intention of allaying rather than of exciting panic, but it contained statements which, at all events, suggested subjects for reflection.—(Hear, hear.) In face of such warnings as those, he did not think it could be said that the scare to which he had referred had been altogether hurtful, or that it was desirable we should relapse into that state of contented optimism from which it somewhat rudely awakened us. Even those who were the foremost in combating anything in the nature of alarm or panic had been forced to admit that there were certain of our industries on which serious inroads had been made by foreign competition; and almost all agreed that in cases in which such successful inroads had been made the cause was in a very great degree the superior excellence of the technical preparation of the workers of foreign countries.—(Hear, hear.) Other things, involving questions of a controversial character, into which he could not now enter, might help to hamper us in the industrial race, but whatever our opinions as to those matters might be, there was no reason why we should not all, whether employers or workmen, address ourselves at once and with energy to a cause which was obvious, which was patent, and as to which there was no controversy.—(Hear, hear.)

ENGLAND HEARTILY SUPPORTS TECHNICAL EDUCATION.

It was very satisfactory to know that before the scare he had referred to had terrified us into it we had taken up the question of technical education in earnest, and that we had done a good deal of late years to remove any inferiority under which we might labour in respect of the technical training of our people. In the county of Durham, as in other counties, when we compared the position of technical instruction in the present day with what it was ten or even five years ago, there was ample ground for congratulation. The officers of the committees of county councils, many of them men of great ability, had accumulated large stores of experience, and the nation now commanded the services of a body of teachers whose efficiency increased day by day, and year by year.—(Hear, hear.) Public opinion was never at any time so favourable to institutions adapted to the local needs of every district, even though those institutions might involve the community in considerable expense. The nation realised as it never had at any previous period that the welfare of its industries depended upon the training of its workers, and still more upon the training of the directors of its industries.

It was recognised now as it had not been until a short time ago that the professional preparation for commerce was a science in itself—that it needed experts to plan it, experts to carry it out and experts to maintain it.—(Hear, hear.) But, of course, in this matter of technical education we had special difficulties of our own to contend with. Our Government could not, by bureaucratic action, impose plans upon localities, however wisely those plans might be formed. The Government

were compelled to take the longer and, let us hope, in the end more fruitful course of stimulating localities to think and to act for themselves.—(Hear, hear.) There was, as he believed, urgent necessity for action swift and prudent, and it rested with the present generation to show whether under our present democratic form of government, the people could address themselves with the necessary sureness of aim and persistency of purpose to frame and carry out plans of education upon which the future welfare of the nation might depend. Democracy was in this respect, as in many others, on its trial. Side by side with us, another country which was not democratic had built up a system of industrial and commercial education that was highly efficient and eminently adapted to the development of the industrial capacities of the nation. It remained to be seen whether we, to whom the idea of bureaucratic interference in any respect was distasteful, we who believed in local effort and local self-government, we who clung almost with a passionate devotion to our liberty to manage our own affairs, were capable of building up an equally efficient system. He believed that this might be done, but he did not believe that it could be done without much effort and self-sacrifice on the part of all of us—on the part of parents, on the part of local administrators, on the part of teachers. While much must depend on local effort, he admitted that something yet remained to be done by the Government, with the assistance of Parliament.—(Hear, hear.)

NEED OF BETTER ELEMENTARY EDUCATION.

The progress already made, the tentative struggles in which we had been engaged for the last few years, had revealed the existence in our educational system of a considerable gap which required to be filled. All the experts were agreed that in order that people might take full advantage of the special scientific courses prepared for them in such buildings as that in which they were assembled they must come better prepared than they did now. The county of Durham's own expert, Mr. Robson, the secretary to the County Education Committee, declared in a recent report that "there must be an organised system of secondary education provided beyond and above our most admirable elementary school course instead of the present chaotic jumble existing between the elementary school and the University."

He was glad to say that the County Education Committee had devoted a considerable amount of attention to the improvement of the secondary schools of the county, but their powers needed to be extended by such a measure as was brought before Parliament last session—a measure which he noticed Mr. Robson, in the same report, in language that he could not help thinking was somewhat exaggerated, described as "the most revolutionary measure of modern times." Although revolutionary, he did not think from the tenour of his report that Mr. Robson disapproved of it. Well, revolutionary or not, he hoped that that measure, or at all events that part of it which referred to secondary education, would very speedily reappear, and not only reappear but, now that some of the controverted questions connected with elementary education had been for the time at all events disposed of, would reappear with some of its revolutionary provisions extended.—(Hear, hear.) As he had occasion to say yesterday in a neighbouring county, we had in this country some of the best and some of the worst secondary schools that were to be found in Europe.—(Hear, hear.) Some in each class were under public and some under private management. He did not think it was too much to hope that by conferring upon the State or upon some local authorities delegated by the State some powers of inspection and examination it might be possible to stimulate and improve those which were good, and by giving adequate warning to parents it might be possible either to extinguish those which were bad or to compel them under pain of extinction to render themselves efficient.—(Hear, hear.) It seemed to him an urgent duty on the part of the Government, assisted by Parliament, to make some such effort to protect parents and to protect the nation from the calamitous results which followed, and which must follow, educational imposture.—(Hear, hear.) Secondary schools in the condition they would be in when reformed would furnish to the technical schools an increasing number of students qualified to take advantage to an extent they could not do at present of the courses there provided for them.—(Applause.) He hoped that although he had devoted his remarks almost exclusively to the one topic of the necessity for improving the scientific and commercial education of our people, they would not imagine for a moment that he was indifferent to the higher aspect of education which concerned the training of the character of the student. He quite recognised that the highest province of education was to raise the character of the student and not only to make him an accomplished workman, but a good citizen, but it was because of the urgent necessity that he felt existed at the present time for cultivating the study of certain sciences and certain arts which were intimately connected with the industrial training and prosperity of the people

that he had on this, as on other occasions, ventured to urge the subject most strongly upon them.—(Applause.)

A vote of thanks to the Duke of Devonshire for his presence and his address was proposed by Dr. Manson (chairman of the Technical Instruction Committee), seconded by Mr. Arthur Pease, M. P., supported by Lord Barnard, the Dean of Durham, Mr. Gurney (principal of the Newcastle College of Science), Mr. Alderman Hugh Bell (chairman of the Middlesbrough School Board), and Sir Joseph Pease, and carried.—The Duke of Devonshire briefly replied, and after a number of other votes of thanks had been passed the proceedings closed.

The Manchaster Guardian, of October 6th, 1897, contains the following concise report of the address spoken by the Bishop of London, at the opening of new Technical and Art Schools in Leicester.

THE BISHOP OF LONDON ON TECHNICAL EDUCATION.

The Bishop of London visited Leicester yesterday in order to open the new Technical and Art Schools which have been built and furnished by the Corporation at a cost of about £40,000. The Mayor opened the proceedings, after which Sir Thomas Wright gave an interesting sketch of the development of technical education in Leicester and the erection of the new school. The Bishop of London expressed his gratification at returning to Leicester in order to open the schools, which he regarded as a signal proof of the life, energy, and vigour of the municipality. A procession was then formed, and proceeded from the Drill Hall to the schools, where the Bishop of London, having been presented by the architect with a gold key, unlocked the gate and declared the schools open. Sir Thomas Wright afterwards presided at a luncheon in the Assembly Room, and was supported by the Bishops of of London, Peterborough, and Leicester.

The Bishop of London proposed "Success to the Municipal Technical and Art Schools." He remarked that the centre of England's greatness and the whole source of England's life consisted in the persistent and regular development of her self-government. No increase of municipal government, accordingly, ought to be the source of other than unmitigated rejoicing. The progress of England in the future, as in the past, depended largely on its technical education. With respect to his own personal knowledge of science, he must quote the phrase of a friend who confessed that he knew nothing whatever about it and had never even taught it.—(Laughter.) As regarded his knowledge of art, he must confess that he had never drawn anything—not even a handcart.—(Renewed laughter.) The Bishop proceeded to point out the break which occured in a boy's education when he left school and became an apprentice, and said the missing link was supplied by the technical schools, which developed the physical alertness in the mechanic and made him in every respect an intelligent man. With respect to the pressure of international competition, it was for the manufacturer to exhibit greater readiness to follow the development of the markets and look out for new openings. It was for them to do the touting for the markets of the world, and follow the example of Germany, which covered Italy and other countries with travellers. The capacity of Germany lay in making colourable imitations of English goods, but which were entirely bad. They looked like the proper thing, however, and were bought up at once. He believed that the English mechanic could do a better day's work than anybody else, but it was because he was English, and not because of his education. Technical education would give him a prospect of a happier and more contented life. The teaching of art, again, would endow him with a sense of beauty, and base his knowledge on the finest feelings which they could posses.—(Applause.)

On the 16th of October, 1897, the Earl of Crewe opened the New Technical Institute at Crewe. In a brief address Lord Crewe referred with commendation to the recent talk by the Duke of Devonshire—on the occasion of the opening of the Darlington Technical College—(see preceding page) in reference to the danger of foreign competition which however he, (Lord Crewe,) thought had sometimes been greatly exaggerated, for, he said, "where the foreign competition depended upon the greater technical aptitude and finer technical training of the workmen, it could be combatted by the improved methods of our own workmen. He was glad that the Technical Institution they had opened that day was intended also, to

advance those industries and employments which particularly concerned women—such as cookery—laundry work, etc.—(Hear Hear)"

The Manchester Guardian of September 17th 1897 gives the following account of the opening of a new Technical School at Preston.

PRESTON TECHNICAL SCHOOL,—OPENING CEREMONY.—SPEECH BY LORD DERBY.

The new Technical School in Corporation-street, Preston, which has been built out of funds provided by the trustees of the late Mr. E. R. Harris, on a site given by the Corporation, was opened by the Countess of Derby yesterday. The Council of the Institute ten years ago came to the conclusion that a technical school would form a fitting memorial of Her Majesty's Jubilee, and the present substantial, and at the same time ornamental, edifice is the result. It has been built from the designs of Messrs. Cheers, Aspinwall, and Smith, and will cost, exclusive of furnishing, probably about £15,000. It comprises a weaving shed—one of the largest in the county,—a large spinning shed, a textile museum, a lecture hall, classrooms, and every provision for teaching the staple trades of the district. Special rooms are set apart for classes in mechanics and engineering, machine and building construction, carpentry and joinery, plumbing, &c. Active steps are at present being taken to equip the building with machinery and all the most modern appliances for teaching the various industrial processes. Some valuable gifts of machinery have already been made by large firms in the district, and it is expected that similar contributions will be received from other sources.

There were about 750 persons at the opening ceremony in the Weaving School. Mr. W. Ascroft presided, and among those present were the Earl and Countess of Derby, Sir J. T. Hibbert, Sir Thomas Storey, Sir James De Hoghton, the Mayor of Preston (Mr. Alderman Davies), Mr. W. E. M. Tomlinson, M. P., and the Rev. G. Steele (vice president of the Institute).

The President, in the course of a brief speech, explained the objects of the Harris Institute, and claimed that those associated with it endeavoured worthily to take their part in maintaining the industrial supremacy of the country.

The Technical School, which they had been able to provide by means of the wise generosity of the first Harris trustees (of whom there were now but two survivors, the Rev. C. H. Wood and Mr. David Irvin), would enable them to do that more effectually. The variety of their work had so much increased, and the number of their students had become so greatly extended, that that new building had become a necessity. In speaking of the art and science teaching at the Harris Institute, he was glad to be able to acknowledge the very handsome gift of £2,600 to the funds of the Institute by the Rev. C. H. Wood and Dr. Hodgson, the trustees of the will of the late Miss Tuson. This gift had set free other funds, and thus enabled them to provide for the purchase and equipment of the Glover-street school, where domestic science was taught. (Applause.)

The Countess of Derby then declared the school open, and expressed a cordial wish for its future success. The Chairman then called upon Lord Derby to speak.

ADDRESS BY LORD DERBY.

The Earl of Derby, in the course of an interesting address, said he was sure Lady Derby's wish was echoed in the hearts of all who had come together on that occasion, an occasion which they hoped would prove to be one of great advantage to Preston in the future.—(Applause.) He referred to the great growth of interest in technical education during the reign of the Queen, and especially during the last decade of that reign. He thought no other movement would so distinctly impress itself upon the future of the country. Not very long before the first Jubilee of the Queen the movement for technical education was only in its infancy, although there were some, the pioneers of the movement, who realised the importance of the question, but still they were a minority, and anyone who had expected to find technical instruction going on through the country would have been woefully disappointed. There had always been a glimmering in the northern counties that there was something to be learned between the ordinary education of a child at school and the later education gained in technical, artistic, or scientific subjects, according to their position in life. The evening schools had always been a marked feature of the educational work carried on in the northern and especially in the manufacturing districts, and at the present moment there existed the Union of Institutes for Lancashire and Cheshire, comprising, he believed, over 100,000 persons, who were connected, some practically, some in theory and good will only, with the work of advancing education out of the ordinary working hours; but the technical instruc-

tion movement had come in to supply much that was lacking. Those who now supported technical education had at their command a supply of funds which was sadly lacking to those who were only advocating the evening schools, but the object was much the same. Technical education showed them how to do on recognised principles that which was to a great extent formerly done by rule of thumb. There was one fear only with regard to technical education, and that was the danger of the various educational means giving in some matters the same instruction. He had been at a meeting in Manchester the previous evening, at which the School Board, the Technical Instruction Committee of the City Council, and the representatives of Owens College had met with a view of obviating that, and arranging that that which was elementary should be taught in the elementary schools, that which was technical in the technical schools, and that appertaining to the highest knowledge in the College. Thus children could be taken gradually from the lowest to the highest educational point.—(Applause.) He did not say that that could be done anywhere. As yet they had not in Preston anything like the Owens College, but it might come in time, and, at all events, they had the various gradations by which children might be taken from one class or another, thoroughly grounded in elementary knowledge, and then drafted on to technical, scientific, or artistic work. He did not wish to speak disparagingly of art, but still in such a land as ours the future depended more on technical work than upon art. He asked where was the sane man or woman who would say that our efforts should be relaxed in regard to this movement. Whatever they might be doing, they could depend upon it that foreign countries also were very much alive to the value of education. He instanced especially the great work which was being done in Germany, and the thorough training which was there supplied to the people. There, he said, they would have in a technical school not one or two looms, but every variety of loom, and the student was taught how to obtain the best result from each one. Englishmen were apt to speak rather disparagingly of anything produced in Germany, but he was not sure that there was not sometimes a note of envy to be detected. Was not Germany advancing at a great rate, whilst England, perhaps, was content to go a little slower? He was afraid that it would be found that, whilst this land had advanced much during the last 15 years, other countries had done still more, and it was essential that this work should be taken up throughout the length and breadth of the kingdom; that education should be valued not only as an abstract possession, but should be applied to the better conduct of that trade in which the people were engaged.—(Applause.)

He hoped the managers of the school would see their way to co-operate with other public bodies. Preston had always been proud of the position it had occupied in regard to its school teaching, and whilst it had its own peculiar way the inspectors reported favourably upon it. They hoped that the same cordiality would be extended towards this new institution, and that the building might prove to be an earnest of that spirit which would hereafter inspire a still larger Preston to carry on the work, and give operatives and others an opportunity of acquiring that technical and scientific knowledge which could only be learned when the two were properly combined. If Lancashire was to continue to hold the position they proudly believed she now held as a leader in technical work, there were those present who by word and deed could assist her.—(Applause.)

The Mayor of Preston moved a vote of thanks to Lord and Lady Derby, which was seconded by the Rev. G. Steele (vice president of the Institute), supported by Sir John T. Hibbert, and carried unanimously. A vote of thanks was afterwards awarded the president, on the motion of Sir Thomas Storey, seconded by the Rev. S. A. Steinthal, chairman of the Union of Lancashire and Cheshire Institutes.

The foregoing instances of the active personal interest taken in the development of Technical Industrial Education by the leaders of English thought and society during the autumn of 1897, show conclusively that no loss of interest has taken place during the decade that has passed since the addresses and papers here collected in Appendices AA, and BB, were published.

Judging from these varied addresses, it would appear that the interest taken in these educational efforts to develope the technical superiority of the English artizan, is far more general on the part of leading English statesmen than similar efforts by American Educators have awakened among American Legislators and leaders in the States and Nation.

It would hardly seem necessary to point out that, in the rapidly growing competition for the world's commerce in the products of Industry, this country can hardly hope to continue to hold its relative share, unless the Technical and Artistic training of its industrial workers keep pace, "pari passu," with that provided for the workers of rival nations.

IV.

TWO INTERESTING PAPERS FROM THE FILES OF THE NEW YORK TRIBUNE; ILLUSTRATING THE ENGLISH AND GERMAN ESTIMATE OF THE VALUE AND IMPORTANCE OF DEFINITE TECHNICAL TRAINING IN INDUSTRIES.

What definite technical training in a particular industry can effect is forcibly shown in a letter from I. N. F., the regular correspondent of the New York Tribune in England.

This letter, published two years ago, (September 8th, 1895,) was largely given to a showing of the advantage accruing to the town of Bradford, from the effect of the lowering of duties on woolen manufactures by the Wilson-Gorman Tariff Act; in greatly stimulating the trade of that English manufacturing centre with the United States.

That portion of this letter of most interest in this connection, and which is the only part here quoted, shows how the workers of Bradford had been so thoroughly trained as to enable the manufacturers to take every advantage of this to them fortunate opportunity; and illustrates how the resulting prosperity of the town had been largely due to the careful training given to the youth of Bradford, twenty years before. This is a striking object lesson, showing the close relations that exist between the thorough technical training of its Youth, and the subsequent prosperity of an industrial manufacturing community.

THE BRADFORD TRADE.—IMMEDIATE EFFECTS OF THE NEW WOOLLEN SCHEDULE IN ENGLAND—VALUE OF TECHNICAL EDUCATION.

BRADFORD, *August* 27.

Bradford was once the dirtiest and worst regulated town in England, but it is now described by Frederick Dolman as the model municipality of its size, which has the honorable record of reducing the death rate in twenty years from twenty-seven to seventeen per thousand. Its pre-eminence as a woollen town is acknowledged all over the world. Huddersfield rivals it in the production of the finest and most expensive qualities of woollen and worsted goods, but Bradford clothes the masses at home and abroad. It is the great emporium from which the clothiers draw their material for ready-made custom, and from which, also, fancy dress fabrics, coatings and every kind of woven texture are supplied for the drygoods trade.

* * * * * * *

WHAT TECHNICAL TRAINING HAS DONE.

The improvement in the quality and design of Bradford goods is attributed by manufacturers and merchants in large measure to technical education. Twenty years ago the woollen and worsted industries of the town suffered severely from foreign competition and commercial depression. Thoughtful men were convinced that a higher class of labor was needed for the production of textile fabrics, and that the prosperity of the great industries of Bradford was dependent upon technical education. The experiment was tried in a small way. The Mechanics' Institute provided looms for elementary classes in weaving and instruction in designing and harmony of colors for advanced pupils. The Chamber of Commerce supported the

project and in a short time there were 400 students in attendance upon day and night classes. A larger building at once became necessary. The manufacturers subscribed generously toward the erection of a technical school designed to develop the principal industries of the town.

The new building was opened in 1882, and subsequently enlarged in order to meet the requirements of classrooms and laboratories for additional departments. It is one of the best schools of the kind in England, and has ministered directly to the prosperity of the town by raising the standards of workmanship in the factories. About 1,300 students now receive systematic instruction from a corps of twenty-eight masters and teachers. The Municipal Council makes liberal grants for the support and maintenance of the school, and enables the managers to provide annually for 150 free scholarships for two-year courses. In this way the doors are thrown open to the sons and daughters of poor artisans.

Professor Huxley explained with characteristic lucidity that the object of technical instruction was "to assist in the diffusion, among the artisans and others occupied in trades and manufactures, of sound instruction in those kinds of theoretical and practical knowledge which bear upon the different branches of industry, whether manufactures or art." In the Bradford Technical School there are dyeing, textile, art and engineering departments, with day and evening classes, in addition to general courses in English studies, mathematics, chemistry, physics and mechanics, and special courses for the civil service or commercial pursuits. The dyeing department has a chemical laboratory with a dyehouse supplied with steam boilers and large vats. To the theoretical study of organic and inorganic chemistry is added in the course of two years practical work in wool and cotton dyeing. Largely in consequence of the training supplied by this school Bradford dyers have improved their processes of coloring all-wool and cotton-warp goods, until they now produce manufactures which rank with the most artistic French patterns. The art department has made a special feature of pattern designing, which has had the effect of diversifying and imparting artistic qualities to Bradford goods. The textile department has expanded in many directions the work of the weaving school, which was organized by the manufacturers in 1877. In the lecture-rooms the cost and properties of raw materials are explained, with the principles of structural ornamentation, artistic design and combinations of colors; and the students learn by practice with hand-loom and twisting-frame how to produce every form of woven texture. The workshops of the engineering department are also well equipped and the classes are largely attended.

A PROOF OF ITS UTILITY.

The most practical recognition of the utility of this technical school in promoting the interests of textile manufacturing is the employment of its graduates as heads of departments in the factories of Bradford and other towns. The manufacturers no longer shrug their shoulders and smile contemptuously over the vagaries of "book learning." They understand fully not only the advantage, but even the necessity of having scientifically trained foremen and expert workers in their factories. In the modern battle for a market, knowledge is power. The tremendous force of competition among nations and communities shuts out inferior workmanship and less artistic products. The survival of the fittest is the victory of the most highly trained industries.

The Bradford manufacturers are convinced that technical education has enabled them to hold their market against France and Germany. They consider it necessary to employ in their factories foremen who have had the advantage of scientific education. They even send their own sons to the technical school to learn in the dyeing and textile departments the art of producing fabrics of the best workmanship and design.

The woollen schedule of the Gorman-Wilson tariff will work out its own results, whether for good or for ill, in the United States; but whether it succeeds or fails, there is an English system of protecting manufactures and elevating the standards of labor which deserves to be carefully studied and closely imitated in the United States. Every English and Scotch manufacturing town of progressive tendencies now has its technical schools, which are either conducted or largely maintained by the municipal government. Those schools are doing a great work for all the important industries in England. It is the German system. Whatever may be the final judgment in America respecting free wool and so-called free raw materials, the value of technical education will have to be appreciated more highly than it is at present if manufacturing industries are to be kept on the highest level of efficiency. There is something that is more important in the long run than the most ingeniously devised machinery. It is the highly trained expert workman.

I. N. F.

The following editorial from The New York Tribune, of September 3rd, 1897, is here inserted, because it contains a concise statement of the number of Technical Industrial Schools in Germany, compiled from an Official Report. As contrasted with similar educational facilities provided in these United States, these statistics furnish food for thought.

GERMAN TECHNICAL SCHOOLS.

That the practical benefits and advantages of technical education and training are to-day better and more generally appreciated than ever before is a fact the importance and significance of which almost everybody recognizes. Even the more staid and old-fashioned English merchants and manufacturers have been constrained to tear aside the veil of prejudice and "conservatism" which had so long enveloped them, and begin to study the nature and causes of the changes wrought by modern commercial and industrial competition. They had not far to seek or long to study before they made some discoveries which were important as well as disagreeable to them. They had already learned that the source of their most formidable competition was Germany, which for some time had been pushing them hard in foreign markets, and, more recently, had actually invaded their home market and begun to threaten their supremacy there as well as elsewhere. They had paid little heed to the growth and spread of technical education in Germany, and had, for the most part, ignored it as one of the factors of competition, either commercial or industrial. It is not putting it too strong to say that the discoveries of the last two years have been as startling as disagreeable to them.

But these discoveries were not new ones, by any means. For more than forty years the States of Germany have been seeking to prepare and equip their people for the industrial and commercial struggles of the future, and chief among the advantages which Germany as an industrial nation now enjoys over Great Britain and every other country in Europe are the wide diffusion and high standard of industrial and technical education and the liberal and intelligent support given by the imperial and various State and municipal governments for that purpose. Germany is simply reaping what it has sown, and all the work of preparation and cultivation has been done before the eyes of the world.

Some interesting and important facts concerning the present condition of technical education in Germany are contained in the report of an investigation made by direction of the Minister of Labor of Belgium. Prussia expends $600,000 for the support of technical schools, and, besides what has been done by municipalities, it has established six special schools for the construction of machines, a school for the bronze industry, one for steel and iron mongery, another for navigation, and schools for the study of pottery, porcelain and painting on glass. But these form only a part of the system of technical instruction, there being 248 other schools in which such instruction is imparted to more than eleven thousand pupils. The greater number of these schools are the outcome of the joint efforts of associations mainly composed of large industrial concerns. Of the schools thus maintained, with some aid from the State, 32 are for painters and decorators, 9 for shoemakers, 16 for tailors, 20 for bakers, 6 for butchers, 26 for smiths, and so on. In Berlin the provision for technical instruction is very complete, and costs the municipality $70,000 a year. In Saxony, which is at the head of all the German States in technical instruction, there are 111 schools in which such instruction is given. Of these, 10 are schools of agriculture and 40 are schools of commerce. Bavaria, besides its higher schools of architecture, commerce and art, has 45 technical schools, with 2,682 pupils, and each school is divided into sections, each of which is devoted to particular features of the industry with which it deals. The Kingdom of Würtemberg has several schools in which weaving and kindred arts are taught, and at the same time new industries are being introduced. For example, teachers are employed for peripatetic courses, and thus the women and girls of one hundred and twenty communes have been induced to devote their time to white embroidery. The Grand-duchy of Baden, with 1,600,000 inhabitants, spends $280,000 a year on technical education. In addition to its schools of architecture, clockmaking and commerce, it has founded schools of cabinet-work and music. In the Grand-duchy of Hesse, which has about 1,000,000 inhabitants, there are schools of architecture and sculpture, 9 schools for artisans, 43 for various industries, and 82 schools of design.

In some thoughtful comments on the report from which the foregoing facts were gleaned, the editor of an English newspaper writes:

"The attempts made to increase the military strength of Germany need not be a source of disquiet or alarm. Militarism is a disease which in the end will cure itself.

What other nations have to fear is not the military strength of Germany, but its industrial development, and the advance it has made during the last quarter of a century is such as to justify a lively anxiety. Its soldiers and its armaments are of far less importance than the number of its factories, the extent of its exports, and the success of its commerce. Its technical schools are turning out a magnificent industrial army, and in this sphere of knowledge the countries that compete with it must quickly improve their skill, if they are not to see the decline of their prosperity."

The example of Germany in establishing and maintaining a system of technical education and constantly broadening its scope is not only claiming the attention but exciting the emulation of other countries in Europe, as the reports of United States Consuls for several years past have repeatedly indicated. One of the more recent of these reports notes the establishment of a textile high school at Brunn, Austria, through the intelligent and energetic efforts of the Chamber of Commerce of that city. There has been a weaving school, but it was found inadequate to meet existing demands, and the merchants and manufacuturers voted to transform it into a textile high school, which will also give "a good general education, including commerce." The site and building are to be furnished and paid for by the commune, the Chamber of Commerce and the manufacturers, while the Empire is to put $75,000 into teaching material, apparatus, etc. The local industries to be benefited have subscribed $14,000 to the enterprise, and are to pay the interest and principal of a mortgage of $64,800 which rests on it. The Consul adds: "It is interest-"ing to note that continued efforts in the direction of better technical schools mark "every new movement in the development of all kinds of industries. Austria is "emulating Germany, and Germany is making renewed efforts to keep the lead."

V.

Summary of Contents of the Forty-Fourth Report of the Department of Science and Art, (London, 1897.)

This official Report "Presented to both Houses of Parliament by command of her Majesty" is arranged under eight titles; of these, only the first two—"Instruction in Science," and "Instruction in Art," are here enumerated. The remaining topics are comprised under the following Heads.

The Government Museums: The Geological Survey: Expenditures for Technical Education,—to be stated in "Return" to be made hereafter to Parliament,—Various Special Reports; of which that on Technical Education in Germany is here quoted in full with copious extracts from the accompanying notes on individual institutions.

SCIENCE DIVISION—AID GIVEN TOWARDS THE PROMOTION OF INSTRUCTION IN SCIENCE.

The Science Division opens with a tabular statement of the number of schools, classes, and pupils under instruction in Science from 1887–1896 inclusive. In 1887, there were 1684 schools, 6,300 classes, 103,0-8 students. In 1896, there were 2583 schools,—10,500 classes, and 196,185 students.

Of the 2,583 schools in 1896, 144 were organized science schools, with 16,654 students. This is a considerable increase on the preceding year, when the number of organized science schools was 112, with 14,850 students. Of the schools in 1896, 132 were in England and 12 in Scotland. 175,990 of the 179,531 pupils under instruction in 1896 in schools other than organized science schools come within the category of these on account of whose instruction payments on the results of examinations are made by the Department. 2,106 of the schools examined in 1896 were in England and Wales, 337 in Scotland, and 140 in Ireland. This is a decrease on the previous year of 33 in England and Wales, of 29 in Scotland, and of 28 in Ireland. The number of students who came up for examination from these

schools was 91,300, a decrease of 16,863 on the previous year. Besides these, 8,518 self-taught students and pupils from classes not entitled to claim payments on results, presented themelves for examination.

A table follows showing the results of the examinations for ten years—1887-1896. Of those examined in 1896, the following particulars are then given:

Out of the 99,818 students who were examined, 30,066 were successful in passing in one or more subjects, and of these 16,551 were successful for the first time. In the previous year 52,079 were successful, and 22,542 for the first time. The figures, however, are not comparable in all respects. After 1889 "geometrical drawing" took the place of second-grade art geometry, and was, until 1895, included among the science subjects. In 1896, it was again included among the art subjects. Again, the abolition, partially in 1893, and wholly in 1894, of the second class in the elementary stage of science subjects affects not only the number of papers passed, but also of papers worked at the examination, one of the objects of the change being to discourage the presentation of pupils for examination who possessed only a very elementary knowledge of the subject. The present "pass" in the elementary stage is counted, though the standard is not quite so high as that required previously for a first class. Again, in the returns for the last year a large part of the students in organized science schools are not included, as those in their first year, and some of those in their second year, are not presented for examination in May, their progress being judged by inspection, according to the new scheme. Had they been presented for examination, the papers worked would have had to be augmented by nearly 80,000, and the papers passed and first classes proportionately increased. The examinations in 1896 were held at 1,996 centres in the provinces, and at 160 in London. Of the papers worked, 108,097 were in the elementary stage and 41,273 in the advanced stage, the number of first classes in each stage being respectively 36,557 and 4,862; while the number of papers in the honours division of the examination was 3,260, of which 172 passed in the first class and 397 in the second class. Examinations were also held in various subjects of science by the Department in the Isle of Man, Jersey, Guernsey, Tasmania, Natal, New Zealand, and South Australia, the total number of papers worked being 520. "The cost of these examinations and any payments on their results are borne by the respective Colonies and Dependencies." For the year 1896 the payments to science schools, exclusive of those made to training colleges, on the results of examinations and on attendances, &c., amounted to £157,916. The corresponding amount for 1895 was £142,542.

ART DIVISION—AID GIVEN TOWARDS THE PROMOTION OF INSTRUCTION IN ART.

(a) *Drawing in Elementary Schools and in Training Colleges for Elementary School Teachers; and Manual Instruction in Elementary Day Schools.*

In the art division during the year ending 31st August, 1896, 20,161 elementary day schools, with 2,250,070 scholars, were taught drawing, and examined under the regulations of the Department. This was an increase of 263 schools, and of 57,820 scholars, as compared with the numbers in 1894-5, when 19,898 day schools were examined, in which 2,192,250 scholars were taught drawing. Besides the scholars who were taught in the drawing standards, 18,209 pupil-teachers and ex-standard scholars were examined in drawing, of whom 8,859 were successful. Of the 20,161 schools examined in 1895-6, 18,976 in England and Wales, together with 47 in the Isle of Man and 17 in Jersey, are under inspection by the Education Department; and 939 schools examined in Scotland are under inspection by the Scotch Education Department; the remaining 182 schools, including 77 in Ireland, are not inspected by either Department. The grants for drawing in 1896 to elementary day schools amounted to £176,224; in 1895 to £164,494.

In 1896, 848 schools were "Fair," 12,850 "Good" and 6,391 "Excellent."

In 1895, 1,484 schools were "Fair," 13,223 "Good" and 5,051 "Excellent." Payments per scholar in average attendance in 1895 and 1896 were:

	1895.		1896.	
	s.	*d.*	*s.*	*d.*
England and Wales	1	8.1	1	9.0
Scotland	1	7.4	1	8.2
Ireland	1	5.2	1	6.1

Eight hundred and seventy-three evening continuation schools were also examined, in which 40,459 scholars were taught drawing, the grants earned by them amounting to £2,105. In the previous year the number of evening continuation schools taking drawing was 698, with 37,460 scholars, the grants amounting to £1,664. Classes for manual instruction in connection with 1,069 elementary day schools were examined, and earned grants amounting to £19,530 on account of 83,220 scholars. In the previous year the number of manual instruction classes examined was 910, and the grants earned amounted to £16,307 on account of 67,470 scholars.

It is further stated that full statistics in detail of Drawing and Manual Instruction in these classes and schools are given in a supplementary volume of this Report, and a summary of totals for several years, in an appendix to this volume.

Training Colleges and Elementary School Teachers.

The annual art examination for the students in residential and day training colleges was held in 1896 at 62 colleges. At this examination 2,366 students took freehand drawing, of whom 492 obtained first class; 2,720 took model drawing, and 936 obtained first class; 2,709 were examined in drawing from models with chalk on the blackboard, and 527 obtained first class; 2,378 took drawing in light and shade, and 289 obtained first class. The total number of individual students examined was 4,759; in 1895 the number was 4,738. The grants for drawing earned by these colleges amounted to £2,431, as against £2,570 7s. 6d. in 1895.

(b) *Art Instruction in Local Schools of Art and Art Classes.*

The number of art schools and classes (including 80 science schools which take art subjects) examined in art in 1896 was 1,851, as against 1,853 (which included 91 science schools) in 1895, showing a decrease of 2. The number of students under instruction was 136,768 in 1895, as compared with 146,193 in 1896. Of these, 142,546 were of the industrial class, as defined in the "Science and Art Directory." Of the 284 art schools and branch classes and 1,487 art classes examined last year, 245 schools and 1,284 classes were in England and Wales, 24 schools and 153 classes in Scotland, and 15 schools and 50 classes in Ireland. The number of students who sat for examination was 78,139 in 1896, or 2 less than in 1895, when the number was 78,141. In 1896 148,872 exercises were worked by students of schools and classes. Of these exercises, 118,705 were in elementary stages (including 12,429 exercises in geometrical drawing), and 29,881 in advanced stages, or in subjects not divided into stages, the number successful in each stage being respectively 69,009 (including 7,873 in geometrical drawing), or 58.14 per cent, for elementary stage (including geometrical drawing), and 21,478, or 71.88 per cent, for advanced stage, while in the honours division 286 exercises were worked, of which 87, or 30.42 per cent, were successful. But, in addition to the papers worked by these students, 9,786 papers were worked by external candidates, and candidates from classes not receiving payments on results, of which 5,452, or 55.71 per cent, were successful.

The following special Report made by the distinguished members of the "Technical Instruction Commission" of Great Britain, is commended to the careful consideration of educators, and statesmen in the United States, as being as important to the American People as to those of Great Britain. It shows, in a striking manner, how closely the material prosperity of a people is linked to, and dependent upon, the educational training given to the youth of a nation. In facilities for Technical Training, and schools for Special Industries, the United States are still far behind the leading industrial nations of Europe.

VI.

Report on the Recent Progress of Technical Education in Germany. To His Grace the Duke of Devonshire, K. G.

My Lord Duke, A cordial invitation having been extended to a number of our party to visit the Electrical and Industrial Exhibition at Stuttgart, and to proceed thence to Nuremberg, where a national exhibition of arts and industries was also taking place, we arranged for a short stay in Germany, in the course of which we

had several opportunities of inspecting schools and factories, and of comparing the existing state of arts and industries with the conditions which prevailed 14 years ago, when as members of the Royal Commission on Technical Instruction, we made an exhaustive inquiry into these subjects. As the time at our disposal was limited, we were forced to confine ourselves to the inspection of a few representative schools and factories, as furnishing examples of the character of the changes which have taken place since our more thorough examination of these countries at an earlier date. We were able, however, to supplement our observations by an inspection of the contents of two important exhibitions, as typical of the existing state of the manufactures of Würtemberg and Bavaria. We had from time to time also the opportunity of discussing some of the questions which interested us with influential educational authorities, manufacturers, and merchants. During our stay, we had, moreover, the advantage of the guidance of Chief Councillor von Diefenbach, whose knowledge and experience of the schools and manufactures of these two countries was of the utmost value to us. Mr. von Diefenbach, it will be remembered, had an important share in the continuation of the great educational movement, inaugurated by the late Dr. von Steinbers, a movement that has resulted in the creation of numerous thriving industries throughout Würtemberg, which, until the middle of the present century, was largely an agricultural country.

At a time like the present, when the effects of German competition have recently been prominently brought into notice and have attracted so much attention in this country, it was natural that this question should occupy our minds; but as in the case of the Royal Commission on which we had the honour to serve, it was our present task rather to compare the means of education available for the industrial classes, and the influence of such instruction on manufacturing and other industries, than to endeavour to ascertain the general causes or the actual results of commercial enterprise. We are aware that any systematic investigation into these causes would necessitate the consideration of such questions as hours of labour, rates of wages, and the economic conditions under which different trades are carried on; and, although in the course of our inquiries we were able to gather information on these subjects, to which reference is made in this report, we have no desire to convey the impression that the accuracy of such information has been scientifically sifted, or that the extent of our inquiries would justify any final conclusions. We may, however, at the outset, state that we were greatly impressed by the progress which has taken place in many of the leading branches of manufactures since we passed through these countries in 1882.

It is satisfactory to be assured that our exports of manufactured goods to Germany compare so favourably with our imports, and that, moreover, the German empire is our largest customer. And while it is possible that the aggregate value of the foreign commerce of Germany in comparison with that of Great Britain has been overestimated, there can be no doubt that in certain industries our supremacy is seriously challenged. Germany is making enormous strides, and notably in those manufactures in which superior knowledge, technical skill, and the agency of the expert in chemistry or other sciences can be brought to bear. This holds good to a remarkable degree in certain industries concerning which we had special means of forming an opinion, namely, in the electrical trades and in the cognate branches of electrical engineering, as also in various applications of printing involving artistic and scientific skill.

We were also struck by the marked improvement in the standard of living of the wage-earning classes, and by the growing tendency to the shortening of the hours of labour. There would seem to be a more prevalent opinion among manufacturers and factory inspectors that there is a maximum "labour day," and that any increase in the number of hours of labour beyond that maximum is bad in its effect on the quantity as well as on the quality of the output.

GROWTH OF INDUSTRIAL DEVELOPMENT IN BAVARIA.

In the year 1882, we were present at the opening of the Fine Arts and Industrial Exposition at Nuremberg, and the exhibition buildings again this year occupied the same site in the beautiful park to the north of the city.

In certain of her industries, on the occasion of our first visit, Bavaria was still, so to speak, in her infancy; now we found large and populous factories, employing thousands of work-people, where formerly there were workshops with but a sprinkling of artisans. Where once she relied upon machinery imported from England, now she produces a steadily increasing quantity of that required for the home trade, and finds new markets in other lands. Her railway system has been greatly developed and extended, and the disadvantage of her inland position and her comparative remoteness from colonial and other markets is to some extent compensated for by very low railway rates for raw materials.

We may mention, as typical examples of progress, two industries which have practically been created since 1882. In that year there was not a single Portland cement factory in Bavaria, but now at one of the works alone 300 hands are employed, and about 50,000 tons of cement are produced annually. This business was founded only in 1885. The electrical works of Messrs. Schnekert & Co. (now the Elektrizitäts-Aktringesellschaft) were only just beginning on a small scale in 1882, and now they employ 3,500 workpeople, and export optical and electrical machinery to all parts of the world.

The development of lithographic colour printing works, such as those of Mr. E. Nister, of Nuremberg, affords another illustration of German enterprise resulting from the readiness of Germans to at once apply new inventions to productive industry. In these works, which are typical of others in Germany, numbers of illustrated books, besides large quantities of almanacs and Christmas cards, intended for the English-speaking markets, are printed, and the success of this industry is no doubt largely due to the scientific skill displayed in the processes of colour printing, as also to the ready supply of well-trained artistic operatives, of whom 140 were engaged in this factory at the time of our visit; the entire staff comprising 750 workpeople. It is worth noting, however, as indicative of the progress of art education in our own country, that nearly all the designs reproduced for the English market were the work of English artists. This very fact, however, only affords an illustration of another cause of German material progress, viz., the intelligent care displayed, and the efforts made to adjust the wares exported, to the tastes and requirements of the market in which they are to be sold.

RELATION OF EDUCATIONAL CONDITIONS TO INDUSTRIAL DEVELOPMENT IN GERMANY.

Among the many causes that have contributed to the advancement of German industry, we would particularly refer to the educational conditions upon which Germany has relied so largely in the past for maintenance and development of her industrial progress.

The Commissioners set forth in their Second Report in 1884 the conclusions at which they had arrived with respect to the educational activity of Germany and the Continent, and it is important to record that since that time there has been no disposition to remain satisfied with past achievements. On the contrary, in nearly every case we found evidences of a determination on the part of the municipalities and of the State to increase and extend their schools, and to equip them with the most modern and improved apparatus. In these days of rapid intellectual progress the school becomes antiquated and obsolete almost as quickly as the factory or the workshop, and again and again we found that schools which had awakened our envy in 1882 and 1883 were being entirely rebuilt and replaced by larger and more serviceable edifices. We shall have to mention, even in the few towns we visited, several instances where we found this to be the case, and the manufacturers who assured us of the importance of these institutions during our previous visit, were not a whit less convinced now of the urgency of the need of the additions and extensions which had since been made.

IMPORTANT NEW ART BUILDINGS IN NUREMBERG AND STUTTGART.

The great industrial art schools of Munich and Nuremberg vied with one another at the exhibition in the variety and extent of the works of their students, and we found that for the school at Nuremberg an entirely new building is in course of erection at an estimated cost of 45,000 *l*. Separate departments are being provided for the day and the evening students, and special well-lighted class-rooms have been designed for all the different branches of art instruction, as well as for art in its varied applications to wood-carving, metal work, and general decoration. This school, when it is finished, will be one of the finest and most complete of its kind in Germany.

The Gewerbe Museum of Nuremberg has likewise outgrown its former habitation, and a handsome new edifice, conveniently situated, is even now partly occupied by the libraries and collections. In addition to the new buildings already finished, it is proposed to erect a separate range of laboratories and class-rooms for the section devoted to chemical technology, which since our former stay in Nuremberg has increased greatly in importance. These buildings when complete will cost 50,000 *l*. In connexion with the Gewerbe Museum there are courses of popular lectures, similar in character to those given at the Conservatoire des Arts et Métiers at Paris, on all new inventions likely to prove useful for trade purposes, and on other developments of science and art processes, which lectures are attended by large numbers of the working classes. In the laboratories a staff of professors and their assistants are employed on chemical research, and students desirous of conducting experi-

ments under the direction of the professors in any special applications of chemical science to trade purposes receive gratuitous instruction. A special feature of this trade museum is the collection of specifications of patents carefully tabulated and open to all inquirers. This collection forms part of the statistical department of the museum, which also contains a history of all the factories of Bavaria, arranged in classes, giving a full account of the processes of manufacture, the number of machines used, the trade marks and patents owned, the horse-power employed, supplemented by any details which the owner may care to furnish respecting the number of the work-people and the annual output.

At Stuttgart a somewhat similar museum, only opened in May last, has cost close upon 200,000 *l.*, and contains specimens of the art products of different countries, arranged after the manner of the South Kensington Museum. We have given a more detailed account of this museum in connexion with our description of the exhibition.

ACTIVITY IN DEVELOPMENT OF SCIENTIFIC EDUCATION IN GERMANY.

If we turn from art to science we find similar evidence, in the various towns visited, of the remarkable development of educational institutions and of such aids to industry as education is able to provide. We are led to believe that much more is being done for the training of those destined for the higher ranks of industry in many parts of Germany than in England, and this, too, notwithstanding the large sums entrusted to county councils and borough authorities under the provisions of the Local Taxation (Customs and Excise) Act of 1890. At Stuttgart we found that an entirely new group of buildings had been added to the Technical High School, one side, the chemical institute, reserved for the practical study of pure chemistry and the other for practical training in electro-technology. The Commissioners reported in 1884 that this Polytechnic had recently been enlarged at a cost of 75,000 *l.* The erection and equipment of these new buildings has cost about 100,000 *l.* Every new appliance that can aid the student in his scientific work is found in the series of laboratories of which this range of buildings consist. It is noteworthy that the instruction given in the Chemical Institute is exactly of the same kind as that given in the universities, and although a special feature of the teaching and of the equipment is the prominence given to electrolysis and to electro-chemistry generally, no attempt is made in these new laboratories to teach chemistry in its application to special industries, that part of the instruction being provided for in the main Polytechnic building. The electro-technical laboratories, housed in a separate part of the building, are perhaps only inferior to those still more recently erected in Darmstadt, and are splendidly equipped with every appliance for advanced practical instruction in all branches of physics.

At Darmstadt, a city of 57,000 inhabitants, the Polytechnic or Technical High School has been entirely reconstructed at an expenditure of about 120,000 *l.* It consists of a main building for the study of mathematics, drawing, natural sciences, and engineering, and of two separate detached buildings, similar to, but larger than, those at Stuttgart, for the study of chemistry, pure and applied, and of physics and electro-technology. No thought nor money appears to have been spared in the erection and equipment of these buildings, which are the most complete of those we have yet seen. It must be remembered, in connexion with the expenditure on the above-mentioned institutions, that the cost of building in Germany is undoubtedly very much less than in this country.

Since this was written we learn that a new Electro-technical Institute has been added to the Royal Technical High School in Hanover, opened by the Minister of Education in October 1895, which ranks side by side with these splendid establishments.

To the instances already quoted may be added the Technical High School of Charlottenburg, at Berlin, which was in process of erection in 1884, and which has since then been completed and extended (at an estimated expenditure of over 450,000 *l.*), and the unique laboratories for scientific measurements and research in the immediate neighborhood of the Berlin School; these when visited by one of our party last year were still unfinished, but they now constitute probably the most complete institute in Europe for physical research.

These instances must be taken as examples only of the steady advance made by Germany in the last few years in the further provision of facilities for the higher scientific training as a means of developing her industries.

POLYTECHNIC SCHOOLS IN GERMANY.

In our report already mentioned, we stated that the number of polytechnic schools was in excess of the requirements of the people, and we attempted to explain the fact by showing that when these schools were originally erected, "Ger-

many consisted of several independent States, which have since been united in the German Empire, and which endeavoured to rival one another in the extent and excellence of their educational institutions." Since then, Germany has had time and opportunity to reconsider her position, with the result that whilst none of these institutions have been closed, others have been erected more modern in construction, more completely equipped, and better adapted to the now generally recognized need for practical instruction.

To mention one instance only of the efforts made on behalf of trade teaching, we may refer to the Weaving and Dyeing School at Crefeld, which was only completed in 1883 at an estimated cost of 42,500*l*. This has been almost doubled in size by the erection of a new detached building, costing upwards of 15,000*l*., for the departmen s of dyeing and finishing; and this school which we then described as the finest of its kind in Europe, and far surpassing anything of a similar character in this country, has not remained satisfied with the position assigned to it fourteen years ago. The cost of this extension has been defrayed by the State.

In fact our recent visit has brought it clearly home to us that the Germans have not ceased to believe in the value of the higher scientific education. On the contrary, they appear now to attach greater importance than ever to the connexion between such higher scientific training and the development of manufacturing industry. No nation not overburdened with capital would continue to erect and equip institutions for advanced instruction and scientific research without a firm conviction of their industrial value. The demand, too, for such higher teaching seems to increase as the facilities for providing it are enlarged. For, whereas in 1884, we stated that the total attendance at the Charlottenburg alone, irrespective of the Berlin University, is now 3,000, while tho number of students in the physical and electro-technical laboratories at Darmstadt is already in excess of the accommodation, and the buildings, which were only completed in October 1895, are now undergoing extension.

Indeed, it is worthy of remark that the same object which called into existence some 40 or 50 years ago the technical high schools has recently led to their extencion and development in a new direction. As far back as that period Germany began to prepare herself for becoming a manufacturing people. It was her belief in the future applications of chemistry to industrial purposes that led to the erection and equipment at a great cost of chemical laboratories, and to the encouragement held out to students to pursue their studies in those laboratories for a period of five, six, or even seven years. The success that has attended the efforts of the Germans to appropriate many important branches of chemical manufacturing industry is well known, and the dependence of those industries on the researches of chemical experts employed in the works is generally recognized. At the Badische Anilin-und Soda Fabrik alone, 100 scientifically trained chemists and 30 engineers are employed.

GERMAN ACTIVITY IN DEVELOPMENT OF ELECTRICAL SCIENCE.

Her brilliant achievements in the field of chemical industries have encouraged her to establish well-equipped electrical laboratories and to develop the practical teaching of physics with the view of assisting the electrical trades, which are comparatively of recent growth. Twelve years ago the Commissioners had to report that the facilities for practical laboratory instruction in electrical technology scarcely existed, or were of the most meagre kind. At that time nowhere in Germany was to be found so well-equipped a laboratory for electrical engineers as at the Finsbury Technical College. Now there are no laboratories in England which can compare in the detail and completeness of their equipment with those we visited at Darmstadt and Stuttgart; and no facilities exist for original and independent research in physical subjects to be compared with those afforded at the Imperial Institute at Charlottenburg.

SECONDARY EDUCATION IN GERMANY.

Our recent visit to Germany has also impressed us with a sense of the advantages which the nation derives from having an organized system of secondary education. To this matter reference was made in the Report of 1884, and we desire to emphasize it. The education of a secondary school is in every way more accessible in Germany than here. The grades and differences of schools are better defined and more clearly understood; the instruction is more disciplinary and exercises a deep influence in the formation of habits and in the training of character; the teaching of modern languages is insisted upon to a far greater extent than in any of our own schools, with results of the greatest possible benefit to the German clerk and com-

mercial agent; the absence of frequent and conflicting external examinations gives more time for careful study; the remission of two years' military service to those who reach a certain standard in a secondary school is a powerful encouragement to steady application; and the fees are much lower than in schools of corresponding grade in this country. There are advantages which count for much in enabling the German youth to obtain a good secondary education and in fitting him for the subsequent period of apprenticeship in the counting house, the merchant's office, or the factory. The German boy acquires at school a stock of knowledge which is at once useful to him, and he also acquires habits of accuracy and learns the significance of attention to detail and the importance of discipline and obedience. Our consular reports are full of references to the differences between the methods of training and aptitudes for commerce in Germany and in England, which in many ways are traceable to the fundamental differences in the secondary education of the two countries.

TRADE SCHOOLS.

As regards trade schools, we found that these are more common in South Germany, as, for instance, in Austria, than in Prussia, and we were struck with the recognition of their importance, as shown by the fact that, in the exhibition at Nuremberg of the products of the different provinces in Bavaria, specimens of the work of the pupils of trade schools were in many cases displayed in connexion with the exhibits of the factory or workshop, indicating the close relation that appeared to exist between the school exercises and the work of the manufacturer. The instruction in these trade schools is essentially practical, and has been very helpful in the development of several of the smaller industries.

The lesson to be derived from all this activity in matters pertaining to education is clearly this, that our foreign rivals are determined to keep well ahead in the matter of facilities for instruction, and not only so in those institutions wherein the highest branches of scientific instruction are pursued. They are convinced that the nation which has the best schools is the best prepared for the great industrial warfare which lies before us, and no money appears to be grudged for the erection, equipment, and maintenance of educational institutions of all grades, and especially of the science laboratories which, as we have seen, are being multiplied in Germany. The great industries of to-day depend more and more upon the successful application of recent discoveries to ordinary manufacturing processes and less and less upon the presence of coal; iron, and raw materials. Cheaper and more speedy means of transit are placing all countries more nearly on a level as regards natural resources. Improved tools and labour-saving machinery are rapidly rendering the manual skill and dexterity of the individual workman (upon which we once so greatly relied) of minor significance, and in the industrial race in which we are engaged nearly all the advantages upon which we prided ourselves in the past are possessed in a greater or less degree by our rivals, and count for little as compared with scientific knowledge and its ready application to the needs of the manufacturer.

As regards the facilities for instruction to artisans, we did not discover that, except perhaps in certain branches of the textile industries, the special technical education of the German workman is superior to that of the artisans of this country, and notwithstanding the existence of evening continuation schools and Sunday schools in many parts of Germany, we have no reason to think that better facilities for technical and scientific teaching are offered to foreign workmen than those within the reach of our own industrial population. Indeed in some respects the recent development of evening technical instruction under our country councils gives an advantage to our own work-people. At the same time there is growing recognition in Germany of the desirability of making further provision for the instruction of workmen and foremen in trade subjects. We are especially impressed with the fact that employers in Germany largely encourage their apprentices to attend evening schools, and, whilst regulations obtain in different trades, we found that in some industries the apprentices have two afternoons free each week for attendance at technical classes.

In the evening schools which we have recently visited the instruction is not so much the teaching of handicrafts, as is the case in some of our own technical classes, but is more distinctly supplementary to the workshop practice. The methods of teaching vary with the subject, and more care is shown in specializing the instruction in drawing according to the trade of the various classes of students than is common in our own schools. In the weaving schools, which are much attended by evening students, the instruction is essentially practical. These schools form a very distinct class, and some of them have been largely developed since the publication of the Report of the Technical Instruction Commission.

ADVANTAGE OF BETTER ELEMENTARY TRAINING OF GERMAN YOUTH.

It is to be noted that the pupils enter the evening classes with a better preparation for technical instruction than our own students, owing to their elementary education having been continued to the age of 14, and to the system of instruction, which in many ways is more formative of sound habits of thought. Moreover, many of those employed in engineering and other works have had the advantage of attending a good secondary school before entering the evening classes, and the kind of instruction which these need is very different from that which can only be assimilated by pupils whose education has been interrupted at an earlier age.

Although, therefore, we are prepared to repeat as regards Germany what we stated in 1884, that there is no organization for evening instruction in science and art comparable to that afforded under the Science and Art Department and for the examinations in technology under the City and Guilds of London Institute, we feel that no conclusion can be drawn from a comparison of the systems of evening technical teaching without taking note of the differences that exist in the elementary and secondary education of the two countries.

In making even these superficial comparisons between the industrial development of Germany and that of England, we economized our time by selecting certain specimen districts in which some of the most important industries of the country are centred, and choosing those the products of which are largely exported. In the inquiry of the Commissioners in 1882, the worsted industry of Saxony was carefully inspected and examined, and it was shown, at that time, that the conspicuous progress of the manufacturers had been materially aided by the schools of art and science, by general artistic, scientific, and chemical training, and especially by the weaving schools, in which the fullest opportunities were provided for the application of science and art to the manufacture of textiles. Undoubtedly the progress in these centres has not only been sustained, but has been relatively increased, as is borne out by the rapid growth of their manufactures and by the increase of their exports.

MR. MONAGHAN, AMERICAN CONSUL AT CHEMNITZ, QUOTED.

In a very interesting interview with Mr. Monaghan, the American Consul at Chemnitz, who for some time has given attention to questions relating to education and industry for the benefit of the United States Government, we received full confirmation of the opinions we had formed in the course of our previous inquiry as to the thoroughness and utility of the training for the work of life which the German students receive. "They begin," he said, "by learning the language, manners, and customs of the people with whom they trade, and by mastering the anatomy of every machine they have to work." This gentleman accompanied us to the weaving school, with all the arrangements of which he was familiar; and not content with verbally describing the influence of the school upon numerous leading designers and manufacturing experts with whom he was acquainted, he conducted us to the business office of a practical designer who had gained his knowledge at the school, and who by his faculty of making patterns that had caught the public taste had lifted the concern in which he had been employed into a prosperous condition. Mr. Monaghan had no hesitation in saying that if his country and ours did not meet Germany more thoroughly and more practically in the school, each would, in the course of a few years, be compelled to yield to Germany the first place in all the higher and more profitable fields of manufacture and commerce.

HAND AND MACHINE INDUSTRIES IN COMPETITION.

As regards worsteds, both in Germany and in England, spinning and weaving had been carried on for centuries as hand industries. The spinning trade in Germany was practically crushed out by England, but the hand looms remained and are still extensively worked as supplementary aids to the family income in the rural districts. With the advent of British machinery the competition with this country began, although it was practically unfelt so long as British manufacturers were busy. Hitherto it has been mainly confined to weaving. The industry has always been much less centralized than in England, and circumstances necessitated that in most of the factories the weaving, dyeing, finishing, and making-up should be done on the premises, an arrangement which is usually in force to-day. The manufacturer by his travellers sells direct to the retailer. The conditions prevailing in the same industry tend in the case of England to economy of production, while in Germany they tend to variety and originality.

It may be noted also that, as in England, certain power looms were employed in the making of common goods for Germany, so the German manufacturers, aided

by protective duties, first used their English looms for the manufacture of these common goods for themselves from yarns imported from England. The competition at the outset was met by efforts on the part of our English manufacturers to overcome the tariffs by still further cheapening this class of goods, a competition which in most instances they were compelled to relinquish. The Germans, however, no longer confine themselves to the manufacture, for export purposes, of one class of goods; and it is now in the better kind of fabrics that, helped by their schools of design, and by weaving and dyeing schools, and by their intimate study of the methods of commerce, they are destined to become our most serious competitors.

PRACTICAL CHARACTER OF THE GERMANS ILLUSTRATED.

The methods pursued by German firms in buying yarn in England for the making of German fabrics furnish an apt illustration of the practical character of their enterprise and education. Within the business experience of many still living, a firm of English merchants in Bradford started a department for the export of yarns to Germany. They did not send an English traveller to Germany, for the simple reason that few English travellers could speak German. They accordingly engaged a German to manage the new department. Very soon Germans found it advantageous to settle in Bradford, where, owing to their knowledge of English, which they had learnt at school, and their ability to keep foreign commercial accounts, they found no difficulty in conducting their business. As a matter of fact, at the present time, the export yarn trade of Bradford is practically in the hands of Germans, concerning whom it may be said that none are more prompt in meeting their engagements or more honourable in their business transactions.

The yarn is distributed by the merchants to German manufacturers, and the German worsted textiles which are imported into this country are mainly composed of yarns made in Bradford. The Bradford trade is a good example, not of the harmful, but of the profitable effect of German competition, and it would be difficult to say which country has benefited the more by it. The annual amount of woollen, worsted, and alpaca yarns exported from England to other countries, largely to Germany, during the following periods of years has averaged as follows:

	lbs.	
1880-85	37,800,000	per year.
1890-95	60,000,000	"
1895	78,900,000	"

RELATIONS BETWEEN BRADFORD, ENGLAND, AND GERMANY, MUTUALLY ADVANTAGEOUS.

Bradford has been the greatest contributor to German success in the weaving of worsted, and alpaca cloths, and Germany has been the greatest contributor to the success of the spinning trade of Bradford by purchasing the yarns manufactured in the district. Even for this gain to English trade we are, however, indebted to German education; for we are told that if Bradford had depended upon English travellers and agents in Germany to push the sale of her yarn, the Germans by this time would probably have been spinning the yarn for themselves, and possibly exporting some of it to England.

At the present time the worsted spinning industry of Saxony is mainly confined to what is known as the French (mule) system, and most of the machinery is made in Germany. Such long wool-spinning machinery as is being employed is still imported from England. In weaving, Germany has passed beyond this point and is largely engaged in the manufacture of her own machinery. In travelling from the Bavarian border northward through Saxony to Chemnitz, we were much impressed by the evidences of growth and prosperity in the manufacturing towns through which we passed. In one of these towns which is largely employed in weaving Bradford yarns, we were informed by the agent of an English loom maker, who, on a previous visit, personally conducted us through some factories, that nearly all the power looms, used at that time, were supplied by Yorkshire makers. In our recent visit we ascertained that there were no longer any resident agents of English makers, but that two loom factories had been erected in the town, and that the import of English looms had almost ceased.

The experience of Saxony in her competition with England in the wool and worsted industries is practically that of other German States in other trades. At first, Germany came to England for the manufactured product, then for the machinery for making the product, and latterly in some instances Germany is

found able not only to use English machinery more effectively than is being done at home, but to compete with us in the production of it. On the other hand, still taking the case of Saxony, we do not find that English loom makers have done less business, or reduced the wages of their workmen since the Germans began to manufacture power looms for themselves ; as a matter of fact the home trade has, so far, increased, and the competition has resulted in additional improvements in the construction of looms and in the machine tools which are so largely used for that purpose.

PRIMITIVE CONDITIONS CONTINUE IN SAXONY AND BAVARIA.

We found in this district of Saxony, as also in much of the country southward, stretching into Bavaria a primitive condition of things which one would scarcely have expected, under the highly developed organization of commerce in Germany. We were informed that there are still about 12,000 hand looms employed, and that in the sparsely populated villages, stretching in every direction from the town of Meerane, nearly every cottage has its loom. The present proprietor and his family work upon their little patch of land, getting out of it all they can, and fill up their vacant time in turn at the loom, or at some other home industry. Our attention was called to a group of women, each with her small waggon drawn by a large dog, bringing her a piece of cloth to the warehouse of the factor or employer, and taking back with her one or two bundles of worsted yarn, besides loaves, sugar, coffee, &c., and oil for the lamp. Some of these hand loom weavers are wonderfully expert. We saw a pattern weaver who cheerfully boasted that he could make his loom do everything but talk. He was at work in a little chamber, in which there were two beds besides his loom, and he was one of 50 employed by the same firm exclusively in the making of patterns. We were frequently informed that orders are accepted for single pieces of complicated patterns woven by hand. The variety and excellence of many German fabrics is explained by the fact that they are made in hand looms; and having regard to the diversity and beauty of the patterns, it is to be regretted that the products of the hand loom as against the power loom have to meet a hopeless competition. The hand loom weavers, and equally those employed on the power loom, have been much assisted by the instruction gained in the weaving school of the town of Meerane, which, established on a small scale 45 years ago, is now installed in a new building, and is attended by over 100 students. We were told that the most earnest of these students are the hand loom weavers from the country districts, and that all the employers had attended the school; and some of the most prosperous of them stated that they owed their success entirely to its influence.

HOME INDUSTRIES IN BLACK FOREST AND THURINGIA.

Besides weaving, a large number of other home industries are carried on by cottagers in their spare time. In some districts, as is the case in Thuringia and in the Black Forest, they carve wood, make clocks, dolls, toys, lace, artificial flowers, &c., and in many of these industries the art instruction they receive at school stands them in good stead. A merchant in Bavaria, whose warehouse we visited, told us that he had 30,000 separate patterns of articles for sale made in cottages, and that he had orders for all kinds of toys, including 120,000l. worth of dressed dolls. Of the toys imported into this country in 1894, the value of which was nearly 1,000,000l. sterling, nearly all came from Germany.

The question of longer hours, smaller wages, and the work of women and children are all to some extent involved, as we have said, in the growing competition which the manufacturers of this country have to face, but we are convinced from our inquiries that there has been in the past, and that there still is in progress, a levelling up of the inequalities between the physical and social condition of the workers here and those in similar trades abroad. In all skilled industries the wages in Germany are rising, and the hours of labour tend to decrease. Child labour has practically disappeared in German factories, as in no case at any works visited by us did we see any children employed.

In certain trades, however, the inequalities in hours and wages that still exist may apparently give to the German employer some advantage over the manufacturer in this country, but we think that this is a factor in the present competition which is yearly becoming less important.

In the attractive appearance, the pattern, and the finish of their goods, and in the excellence of the packing, the German producers take infinite pains, which it clearly pays them to take. In these directions many of our country-men have undoubtedly much to learn.

The Merchandise Marks Act, as it now operates, was generally spoken of as a strong weapon against ourselves; and while the forging of trade marks, for the prevention of which it was originally devised, has long been been illegal, the measure tends to act as an advertisement of the industries of our foreign rivals, and serves to indicate to the colonial and American buyer the true origin of much that he had hitherto been in the habit of regarding as English.

In many parts of Germany great efforts are being made to extend the provision of light railways, and to stimulate trade by the lowest possible rates of carriage. We were assured that merchandise abroad is conveyed at a much lower rate than in this country. The remoteness of the country from the coast renders this the more necessary and the more difficult to introduce generally.

GREAT ACTIVITY IN GERMANY BOTH IN TECHNICAL EDUCATION AND IN INDUSTRIES.

We shall have accomplished all we hoped to do as the result of our somewhat hasty mission if we succeed in showing that there is no evidence of standing still or of being satisfied with past progress in any direction in Germany. Everything is still being developed, and in all branches of industry there are signs of great activity. New factories are being erected and new processes are being invented. Indeed there are indications that in the immediate future our own country-men will have to encounter a competition far more acute than anything they have yet had to grapple with. In the coming struggle for trade, our fine insular position, our splendid race of workers, and our excellent raw materials will undoubtedly count for much, but the possession of these advantages alone will not suffice, and we shall have to adopt certain of the methods which prevail abroad, about which our manufacturers in the past have cared too little, but which mean much to our customers. We must not be content to live any longer upon the traditions and reputation of the past, but we must set ourselves to work diligently to study the wishes and fancies of those we have to serve, and we must, moreover, be prepared to meet them even in such small subtleties as weights, measures, and packing. Above all, we must endeavour to improve and to develop our higher, industrial, and secondary literary and technical educational machinery, and, whilst adapting this machinery to our peculiar conditions, we must see that it is maintained at least on a level with that of any other nation.

We append some of our notes at greater length on the schools, exhibitions, and upon certain of the factories visited by us, which notes have served as the basis of the conclusions that we have ventured to submit for your consideration, and we trust that we may be permitted to take this opportunity of expressing. through Your Grace, the obligations we are under to Her Majesty's Ambassador at Munich, the Ministers of Church and School Affairs of Würtemberg and of Bavaria, and the officials of the exhibitions in those countries, as also to the numerous manufacturers and others who afforded us opportunities for the prosecution of our inquiries.

We have the honour to be, Your Grace's obedient humble servants,

(Signed)

PHILIP MAGNUS,
GILBERT R. REDGRAVE,
SWIRE SMITH,
WILLIAM WOODALL.

We regret that we were unable to accompany our late colleagues of the Technical Instruction Commission on their recent visit to Germany. We have, however, had the advantage of reading their Report, and we desire to say that we are in general agreement with the opinions expressed by them in regard to the instruction to be derived from their observations.

(Signed)

B. SAMUELSON,
HENRY E. ROSCOE.

I have had independent opportunities of verifying the conclusions in respect of the mischievous operation on our trade of the Merchandise Marks Act, of the burden imposed, more especially on our exports, by the comparatively high rates of the British railways, and of the great advantage derived by foreign manufacturers by the superior training of their commercial travellers.

(Signed) B. SAMUELSON.

DECEMBER, 1896.

NOTES ON SCHOOLS, EXHIBITIONS, AND FACTORIES.—THE DARMSTADT POLYTECHNIC.

The new Polytechnic at Darmstadt, erected in place of an earlier building, was specially visited in order to see the most recent development of schools for the highest branches of technical teaching. The main building is three storyed and comprises three wings at right angles to it, giving an E-shaped plan. These buildings are devoted to the teaching of mathematics and some branches of natural science, and to the schools of architecture and engineering. In the wing buildings, moreover, the first year students receive their instruction.

Opposite to the front entrance to the Polytechnic, and on the other side of the road, are two separate institutes, one of which contains the physical and electro-technical schools, and the other the chemical laboratories and class-rooms. In the rear of the main building is the engine-house, from which electric light, and power and heat, are supplied to all these buildings. The Polytechnic, which was begun in 1893, was completed in October 1895 at a cost, including fittings and equipment, of about 120,000*l*. The main building contains the usual series of drawing offices—a special feature of every technical college in Germany—rooms to contain the collections of models and apparatus, the engineering laboratories, class-rooms, lecture-rooms, a large hall, the library, and the offices for the administrative staff.

The most interesting department of the institute is undoubtedly that devoted to the physical and electro-technical schools. This is divided into two distinct sections; the one for instruction in physics proper, including electricity, and the other for the technical applications of electricity. It is in this special direction that so much progress is being made in Germany, as evidenced by the new buildings at Berlin, Leipsic, Hanover, and Stuttgart. Each section of the physical school contains workshops for the making and repairing of apparatus, but these workshops are not used by the students. In fact it may be said that manual training of this kind does not even now form any part of the curriculum of the students at the German technical high schools. They are required, however, during their course of study, to spend part of their long vacations in engineering shops and arrangements are made for the admission of students to the State railway works, or to the machine shops of well-known electrical firms.

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There are already 300 students in this one department of the Darmstadt High School, and the building, which was completed in October 1895, is now being extended.

The course of instruction covers four years; the first year is spent in the main building, in a general course of scientific study, the second is given to physics; and the last two years are devoted to practical exercises in the electro-technical institute.

The chemical school is housed in another separate building, which also consists of two departments; the one for the study of pure chemistry, the other for the study of chemical technology, electro-chemistry, and pharmacy.

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The attendance of regular students in the various faculties during the past year amounted in all to 850, and there were 104 occasional students, making a gross total of 954. The teaching staff consisted of 27 ordinary and of six extraordinary professors, 22 demonstrators, and of 22 assistants, making a total of 77. The students' fees vary from 8*l*. to 12*l*. a year, and the deficit on the cost of maintenance is defrayed by the State.

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THE NEW BUILDING OF THE STUTTGART POLYTECHNIC.

We also visited the recently-erected buildings for chemistry and electro-technology that have been added to the Technical High School of Stuttgart, which, as is well known, is one of the oldest polytechnics in Germany. On the occasion of our visit in 1882, we found that considerable extensions had been made in 1879, consisting of two new wings, at a cost of little short of 75,000*l*. The present buildings, which are entirely detached and situated at some distance from the main building, have involved for their erection and equipment an expenditure of about 100,000*l*. One-half the building is devoted to the chemical department, and the other and rather smaller half is allotted to electro-technology. There is a substantial basement with two lofty storeys above ground. The chemical department is devoted to the teaching of pure chemistry, inorganic and organic, and the laboratories in the main building, which were previously used for this purpose under Dr. von Fehling, are

now occupied by the professor of chemical technology, Dr. Häussermann. The new laboratories, which are housed in what is practically a separate and distinct building, have been planned with the utmost care and forethought. They have accommodation for 76 students, and there were 62 students last year in attendance. The laboratories have been opened only a year and a half. The course of instruction occupies six semesters; many stay less time and go on to the university; but the majority of the students continue their studies either at the Polytechnic or the university beyond the three years. The first year is devoted to inorganic analysis, the second to organic analysis, and the third to research work. The laboratories and lecture-rooms are very completely equipped. Besides the ordinary lecture-rooms and laboratories, are special rooms for accumulators, for motors and dynamos, dark rooms for photographic and photometric experiments, rooms fitted with furnaces for metallurgical work and the usual balance-rooms.

The electro-technical department adjoins the chemical laboratories, but occupies a separate building. It is under the general direction of Dr. Dietrich. It was constructed for 120 students, and during the last session there were about 75 students in attendance. Commodious as is the building, we were told that there was not room for more than 20 advanced students. The institute contains a large number of small laboratories, specially fitted for experiments in some one branch of electrical work. Several of these laboratories were intended to be occupied by one student only.

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The course of study occupies eight semesters or four years, and during this period the student is expected to spend one year with a firm of engineers. The students seldom complete their school course before 18 or 19, and rarely pass their qualifying examination as engineers before the age of 24.

THE CREFELD WEAVING SCHOOL AND THE NEW SCHOOL FOR DYEING AND FINISHING.

The 12 years which have elapsed since the publication of the Commissioner's report have served still further to test by practical experience the value of the several weaving schools which are found in different parts of the continent. The most important of these formerly visited by us was the weaving and dyeing school at Crefeld, and as we were informed that this school still takes the lead, we inspected it with some care under the guidance of Herr Lembeke, the director. At the time of our previous visit to Crefeld, the school was situated on the outskirts of the town, the population of which did not exceed 90,000; at the present time the population has increased to 110,000, and handsome streets and important buildings surround the school. The school was originally erected at a cost of 45,000l., and it was anticipated that the accommodation provided would be amply sufficient for the wants of the whole district for many years to come. We found, however, that the dyeing and finishing departments had for some time become too small, and as they did not admit of enlargement a new building had been erected for these branches of study on a piece of land outside the town at a cost of 15,000l. The rooms in the original building thus set free are to be fitted up with a complete set of cotton spinning and knitting machinery, and the instruction generally has been so extended as to cover the whole range of complicated details in connection with the designing, weaving, dyeing, and finishing of textile fabrics.

Of the many interesting features of this school, the museum, which is said to contain the finest collection of textile patterns of the world, is the most noteworthy. The decorations alone of these galleries have cost 6,000l., and the librarian in charge told us that the museum had been visited by over 10,000 persons during the present year, whilst designers from different factories visited it daily, many of whom would be found engaged there, often at the same time, in copying and drafting patterns. As the result of the exhibition of Persian and Turkey carpet patterns, an industry for the making of Smyrna worsted rugs had been recently started in the town, giving employment to 120 operatives.

The library and reading room, which are open to the public on certain days in the week, are well attended, and contain all the important textile books that have been printed in any language, including the British textile journals, which are found displayed on the tables. The sum of 15,000*l.* was originally granted for books, but this amount has since been increased.

We inspected the several designing rooms, class-rooms, art studios, and lecture theatres, rooms for the decomposition of patterns and the collections of raw materials, and we found nothing wanting to make the equipment of the school thoroughly up to date. In the spacious quadrangle, the large top lighted weaving shed, con-

tains 88 different kind of power looms, several of which are run by separate electric motors, besides 44 hand-looms. We were informed that in no factory in the world, and certainly in no other school are found so many varieties of looms, or woven fabrics.

The new dyeing and finishing school consists of a lofty three-storeyed building, containing a series of top-lighted sheds for the machinery and work-rooms. The laboratories for the analysis of colours and for private research are very extensive, and the dyeing school contains every essential that is found in the most complete dye-houses. The finishing department is equally well equipped, no expense having been spared either in the provision of the largest machines, or of the smallest details. We were told that no commercial establishments were better equipped than this school, and that consequently every student passing through it had the advantage of starting on his business career with the full knowledge of the newest facts and methods.

SCHOOL AT CREFELD ILLUSTRATES VALUE OF HIGH ARTISTIC AND TECHNICAL INSTRUCTION.

The school at Crefeld with its departments for the application of art and science to the designing and dyeing of silk fabrics must be regarded as affording another instance of the belief of German manufacturers in the value of the best artistic and technical instruction. They recognize that it is the design and finish that sell the fabrics and they have therefore spared no expense in the equipment of their schools, and in the provision of the best instruction.

By the President of the Chamber of Commerce and by other leading citizens, the school was represented as the centre of inspiration for the manufacturers of the whole district. The designers who have passed through it are kept in touch with all that it can teach by attending the conferences and lectures. If they wish for the adaptation of old forms and ideas in making their patterns, they go back to the best designs of every period. In the dyeing and finishing departments all new processes and colours are tested and analyzed, so that nothing is left to chance. The silk industry of Crefeld, like that of England and France, is exposed to constant fluctuations, and for some years, especially in those following the enactment of the McKinley Tariff Bill in America, it was greatly depressed. In 1894 the silk exports of Germany amounted in round figures to 7,400,000*l.*, but rose in 1895 to 8,300,000*l.*, of which improvement perhaps the principal share came to Crefeld. One of the large manufacturers informed us that formerly his firm employed 3,000 hand looms, but they now used only a tenth of that number. In the transition from hand to power looms many weavers have suffered. But in spite of tariffs and competition, and changes of fashion, it was maintained that Crefeld had kept abreast of the times, and had grown in material well-being and population, while the silk industry in England has been languishing. Indeed, Crefeld sends the bulk of her productions to England It was pointed out, moreover, that owing to the many directions in which the school had fostered practical teaching, it had become possible, when the silk trade was depressed, to initiate new textile industries in Crefeld, which might serve to occupy her machinery and find employment for her artizans.

THE TRADE MUSEUM OF NUREMBERG.

On the occasion of our visit to the Gewerbe Museum, Nuremberg, we were met by Herr L. Erhard, the Curator of the Mechanical and Technical Division of the Museum, and Dr. P. J. Ree, the Librarian and Secretary. Handsome new buildings were nearly completed to replace the old ones in the centre of the town, which have been largely given up. This institution, described by us in our former reports, is somewhat on the model of that of Stuttgart, but contains features which are peculiar to it. The Director of the Museum is Herr Th. v. Kramer, who is also the architect and director of the Exhibition. According to the prospectus the work of that institution is carried on under eight different divisions:

1. The collection of patterns or samples, which consists of 10,000 specimens of ancient and modern examples of works in wood, metal, glass, clay, leather, and paper, also woven fabrics, embroideries, laces, &c. Certain of these objects can be obtained on loan. This section is really the applied art museum, as the specimens comprise examples of workmanship from all countries, and of the best periods of art.

2. The collection of designs, which consists of some 60,000 sheets of illustrations of art industries of all nations. These mounted sheets are classified under various heads, and arranged in glass cases for easy reference by manufacturers and students.

To procure these designs, recourse has been had to illustrated works on ornament and art workmanship, and to the best serial publications of all countries. Opportunity is afforded for consulting them and for copying them, and the officials undertake to prepare special designs and sketches, for fees to be arranged.

3. The library and reading room contains upwards of 13,000 volumes of art, industrial, and technical works, also about 136 journals and periodicals relating to these subjects, which are taken in regularly and filed. In connexion with this section we noticed an extensive series of foreign directories, trade catalogues, and address books of other countries.

All the above departments are open free to the public.

4. The Mechanical and Technical division may be said to include two chief departments:

Section I.—The office for specialized trade information relative to:—

(*a.*) Patents, merchandise marks, and trade marks. In this section applicants can have patents secured for them at fixed charges, and trade marks can likewise be registered.

(*b.*) For furnishing information of all kinds on motors, machines, tools, raw products, and manufactured goods.

(*c.*) For supplying literary advice and references from technical works. Replies to general technical questions.

Section II.—This constitutes the experimental research department, arranged for the trial and testing of gas, benzine, and petroleum motors, steam-engines, water-wheels, turbines, and electro motors, as also all labour-saving machinery at agreed charges.

5. The chemical laboratory, which occupies itself with investigations of all kinds relative to technical and industrial chemistry, and further, is prepared to undertake analysis, and to carry out more extensive researches for fees to be arranged. The official testing station for paper is in connexion with this branch.

6. A permanent exhibition of modern industry and art. Temporary exhibitions of special departments of manufactures. Distribution of prizes to meritorious exhibitors out of a fund founded by King Ludwig of Bavaria.

7. Issue of the Bavarian trade journal delivered to subscribers of the institution at the price of 10 marks; to non-members 16 marks per annum. This is the official organ of the Bavarian Industrial Museum.

8. The delivery of public lectures and addresses during the winter months, embracing information on all subjects of art applied to industry and every branch of manufacturing activity. Lectures to the members of allied societies in other towns. Classes for technical drawing for adults engaged in industrial pursuits.

An interesting feature in the activity of this Museum which was brought under our notice was the so-called Gewerbe-Archiv, or factory register, which includes a brief account of all the more important industrial establishments in Bavaria, contributed by the manufacturers themselves on a special form. The particulars given are as follows:—The name and address of the firm; when founded; articles produced; whether special to this undertaking; character of motive power employed; nature of machinery used, and the number of each kind of machine; patents, trade marks, &c. owned by the firm, with indications of registered number, &c. of the same; exhibitions in which the firm have taken part and prizes and medals awarded. Further, as optional information, the number of work-people employed and the annual value of productions. Many thousands of manufacturers have already contributed to this register, and every effort is made to keep it up to date and to render it accurate and complete as a record of the whole of the industries of Bavaria.

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The Stuttgart Exhibition.

The Stuttgart Exhibition of 1896 comprised two distinct sections, each of which was contained in separate buildings, namely, an electro-technical division, displayed partly in the Städtische Gewerbe halle, erected by the Municipality for the Exhibition of 1881, and partly in the town gardens adjoining the same; and the artistic industrial section, which occupied the ground floor of the handsome new Landes Gewerbe Museum, recently erected at a cost of nearly 200,000l. to contain the collections and staff of the Central stelle.

The architect of this latter building, Professor Nickelmann, has most ably overcome certain difficulties entailed by the irregularity of the site, and has created a series of beautiful facades and a magnificent central hall, which latter has been named the König Karle Halle, as a memorial of the late King Charles.

The principal front of this museum towards the Kanzleistrasse has two arcaded storeys, with a lofty attic, flanked by circular towers, which conceal the unequal angles formed by the side streets. The grand staircase is in the central hall, which is surrounded by the frescoes painted by Professor Keller, and this was regarded as the place of honour of the Exhibition, and was reserved for the chief exhibitors in jewellery and the precious metals. Prominent in this section was the fine centre-piece contributed by Messrs. P. Bruckmann and Sons, of Heilbroun, who are among the largest silversmiths in Germany, and the collective exhibition of the Gmünd manufacturers, to the number of ten in all.

The Electro-technical exhibition, in which upwards of 400 exhibitors took part, not only filled the Gewerbe-halle and a temporary annexe for machinery, but it also occupied a specially-erected house in the adjoining grounds, in which every possible process connected with the domestic applications of electricity was shown in operation. A so-called "Gewerbe-dorf," or industrial village, adjoined the main building, and comprised all kinds of small industries in which electricity was called into play, either as a motive power, or for heating and lighting; these applications being, as a rule, shown in action. It was an admirable conception on the part of the architects, Messrs. Schmobel and Stähelin, to give to the buildings composing this village the character of some of the mediaeval structures of Würtemburg and the ancient dwelling-houses, recalling, as they did, the past industrial activity of Southern Germany exemplified, in their use on the present occasion of the most recent applications of electricity, the vast improvements with which modern science has endowed the workman of to-day.

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The new Landes Gewerbe Museum, which was opened for the first time in connexion with the present exhibition, will take over the work of the Central stelle, and will contain the valuable collections formerly housed in the Legionskaserne. Some of these objects were acquired so far back as 1849 at Paris and at Leipsic in 1850. Among the museum collections special mention should be made of the "Musterlager" or pattern depôt, the object of which is to bring before the manufacturer the most important improvements and modifications introduced into various trade processes, the most recent tools and appliances adopted in other countries, the best sources of raw materials and the chief markets for produce, while an effort is made to supply the latest information likely to be of value to the manufacturers and work-people of Würtemberg. The collection is divided into 16 classes, and comprises upwards of 21,000 exhibits.

LIBRARIES AND ART COLLECTIONS.

The Art library, with about 4,000 volumes of drawings and designs, and the Science library, of 53,000 volumes, have been specially arranged to aid the manufacturer and the art workman. The collection of casts with about 1,700 specimens, is housed in the top floor of the Museum in well-lighted galleries. The admirable collections of furniture, metal work, glass, and porcelain are displayed in specially designed galleries round the central court, and some fine examples of Chinese and Japanese art form an adjunct to the art section of the Museum. During the present exhibition a considerable part of the floor-space of the Museum is used for the Art Trades' Exhibition. The spacious entrance hall contained on the right a fine collection of musical instruments for which the country is famous, and on the left an interesting display of church furniture, decorations, and metal work, wood carvings, and some splendid embroideries. Passing through this department, we entered the gallery devoted to the textile industries, largely linen, much of which is richly embroidered, and here, also, were shown embroideries and needlework from the various women's work schools. The next range of galleries contained the collections of wood-work, common furniture, clocks and pottery and porcelain, also some carving in wood and ivory. The central hall and the galleries to the right and left contained some of the finest examples of the industries of Würtemberg, the gold and silver work and the art furniture. The library on the first floor was temporarily occupied by the display of the graphic arts and the lecture room was given up to the pianofortes. The upper galleries of the central hall contained the leather work and collections of porcelain, glass bronze, and metal work. There were upwards of 200 exhibitors in this section of the Exhibition, and in point of excellence of workmanship and artistic design we should be disposed to award the place of honour to the exhibition of silversmith's work and jewellery. We were less pleased with the furniture, which was on the whole somewhat massive and overladen with ornament. A special building was erected, adjoining the Gewerbe Halle for the heavy machinery, and the smaller and lighter objects were displayed in the Gewerbe Halle, which lends itself admirably for exhibition purposes.

One of the most important collections here shown was that contributed by the Würtembergische Metallwaren-Fabrik of Geislingen, where every description of electro-plated goods are manufactured on the most extensive scale. The designs and execution of many of the objects which were very tastefully displayed, showed great merit, and we should be inclined to assert that in no branch of her industry has more progress been made in recent years in Würtemberg than in the manufacture of gilt, silver, and nickel-plated metal work. It is here, moreover, that the assistance of the skilled craftsman and designers has been most fully called into play, and some of the best artists of Germany have been associated with the productions of Geislingen. A new process of metal work which greatly interested us was the so-called "galvano bronze," by means of which an electro-deposit of great thickness and of guaranteed durability is encrusted upon plaster. Large statues and very substantial architectural details have been produced in this way, and it is claimed that the works, though far cheaper, are quite equal to an ordinary bronze casting. A peculiarity due to the mode of production is that these objects are entirely devoid of the usual metallic sound on being struck. The results of this process were, we believe, here exhibited for the first time upon a large scale.

The Nuremberg Exhibition.

The Bavarian National Industrial and Art Exhibition, held this year at Nuremberg, was situated in the beautiful public gardens to the north of the city, and occupied the same site as the previous Exhibition visited by us in 1882. It was contained in handsome and appropriate buildings specially erected for the purpose from the designs of Herr v. Kramer, the Director of the Gewerbe Museum. The style chosen for the main building was that of the Classic Revival; the buildings were wood-framed, covered with cement slats and plastered; the external colouring being pure white. The general elevation contained a single order with entablature which was sufficiently lofty to mask the roofs of the sheds behind. This arcaded façade served as a corridor of communication and was quite distinct from the buildings at the back. The central pavilion of the industrial section, which was much more lofty than the wings, was crowned with a well-designed cupola, supported by a group of columns with arched interspaces. The wings were terminated by quadrants and pavilions with double archways surmounted by obelisks. The general arrangement of the main building was that of a lofty central hall, from which branched out on either side a series of smaller transverse courts at right angles to the main gallery. The large hall had an open timber roof, and this was heavily festooned with garlands of pine branches, which, contrasting with the brown timber, had an excellent effect. This hall, for a considerable part of its length, was free from exhibits, and furnished a wide and spacious promenade. The side galleries were allotted to the eight provinces of Bavaria, and each province fitted up and decorated its own space without any regard to what was being done by its neighbour.

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Considerable trouble had been taken to represent the industry and activity of some of the more remote parts of the province, the wood-carving and furniture of Berchtesgaden was shown by a collective display of 17 exhibitors, prominent among which was the work of the drawing and carving school. It was evident that great improvement in taste was being effected by the agency of this school, established under Government auspices. The school, which was founded in 1840, contained last year 32 students. The whole work of the school was well shown in a series of graduated examples in drawing, modeling, and carving. The Werdenfels district, of which Garmisch is the centre, also contributed a very tasteful display of its industries, in which 79 exhibitors took part. Here there were several collections of the carving-school work from Oberammergau and Partenkirchen; also a display of the works of the students at the violin-making school of Mittenwald.

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Passing onwards, the next court we entered was devoted to the industries of Upper Franconia, in which Bamberg and Bayreuth are the most important towns. The industrial societies of the former city united to contribute a collective exhibition of a very successful character. It took the form of a chapel with stained glass windows, wall decorations, carved altar-pieces, handsomely bound missals, and rich embroideries. Much of the furniture in this section was interesting and characteristic, the designs being based on the mediaeval models. The basket-makers of the Lichtenfels district also formed a collective exhibition in which prominent place was given to the local basket-work and drawing school, which has contributed so greatly to the improvements effected in the productions of this neighbourhood. We were told that the entire display had been purchased for America. The granite

from the quarries in the Fichtelgebirge is widely used, and was well displayed in a special court. The textile manufacturers of Münchberg and the vicinity, who have greatly benefited by the weaving school founded in 1855, made a collective display of their productions, the centre of the court being allotted to the school work which embraced examples of both practical and theoretical teaching. The work in this neighbourhood is still chiefly done on hand looms. The school has an average attendance of 18 students.

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EXHIBITIONS BY INDUSTRIAL ART SCHOOLS.

A special section of the Exhibition building was devoted to the display of the work of the higher schools, both for artistic and industrial training. It was interesting to find side by side the collections contributed by the two great Industrial Art Schools of Bavaria, the Art school of Munich, and that of Nuremberg. Here were to be found examples of the designs of the students in all the various departments of art industry covered by the very extensive programme of three institutions. Thus at Munich, where the male and female students work in separate divisions, there were very complete sets of specimens of the whole course of work comprised in each section. Decorative painting, industrial design, wood engraving, glass painting, metal chasing, and carving are all practically taught, and the specimens of school work were extremely good. It would be difficult to say whether the designs from this school or those from the other school of the same rank at Nuremberg, which also had a most admirable collection of students' works, were entitled to the place of honor. In its modelling and in some branches of applied art perhaps Nuremberg should take the first place, while we should award the palm for decorative painting, studies from the life, and stained glass decoration to the Munich Art School. The former school sent some extremely meritorious specimens of the work done in its evening classes by apprentices and workpeople. It would seem that the Munich school secures a larger number of middle-class day students than Nuremberg does. We have little hesitation in stating that both of these schools still stand in the highest rank for the admirable character of their applied art teaching.

The Royal real-gymnasium of Nuremberg contributed a large collection both of the works of its students and of its teaching apparatus, also a cabinet of minerals and fossils for school use. A similar collection was sent by the Nuremberg-Kreis-real-schule.

One of the most important displays in this section was that made by the Industrial Schule of Nuremberg, which comprises sections for mechanical technology, chemical technology, and building and architectural work. This school gives in its workshops and laboratories a very complete course of practical teaching, as evidenced by the specimens of machinery and the drawings and models from the mechanical section, the important collection of chemical preparations and apparatus from the second section, and the architectural details, wood models, and designs for buildings of all kinds representing the building trades' section of its activity.

Another school which confines itself more especially to instruction in building and engineering, the Building Work and Mechanical Construction School of Nuremberg, only founded in 1870, appears to be well attended both as a day and evening school, and sent a very extensive series of students' drawing of great excellence and embracing nearly every branch of building operations.

The display of school work was fairly representative of all the different types of secondary schools, and there was a very good collection of evening school work, and of the teaching in women's work schools and night classes for artisan students. We spent a considerable time in the examination of this section of the Exhibition. In a neighbouring court we found a series of examples of the displays made by some of the leading manufacturers of Bavaria at the Industrial Exhibition of 1840. It was, indeed, astonishing to contrast the samples of the products in that year with the specimens of the activity of the same firms on the present occasion; a few bundles of rough pencils being representative of the huge factories of the Fabers, and some small glass saucers, filled with colours, sufficing to display the activity of the vast enterprises which have been created in the colour trade.

In connexion with this portion of the Exhibition were the splendid collections sent by the Department of State Railways, the Post and Telegraph Administration, the Royal Mint, and certain Government departments under the Ministry of the Interior, viz, those for mining, river purification, water supply, public works and buildings, fire insurance, and meteorology.

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MR. E. NISTER'S COLOUR PRINTING WORKS, NUREMBERG.

We visited on September 24th the extensive colour printing works of Messrs. Nister & Co., in a large building recently erected near the Lanfer Thurm, seven stories high, in the style of the ancient architecture of Nuremberg. Over the main entrance, inscribed in letters of gold on a marble tablet, was the following sentence:

"What work has won
Work will retain
Through the long centuries,
Thus God decrees."

We were received in the offices of the director, M. Theodor Loefftz a richly decorated suite of rooms, one of them fitted up with glass cases containing a very interesting collection of the productions of the firm, which comprised Christmas, Easter, and birthday cards of all kinds, fancy almanacks, children's picture books, and decorated porcelain. The decoration of pottery with chromo-transfers, at first practised by French manufacturers, has been recently introduced here, and great perfection has already been attained in this branch of work. Large sheets of transfers are prepared, and after being printed over the glaze are fixed in the enamelling kiln, giving the appearance of the finest hand painting at a very cheap rate. We did not see any gilding by this process, but the figure painting and much of the flower painting were very delicate and refined. It appears that Mr. Nister's process has not yet been taken up in England.

The taste of the cards and picture-books was eminently that of the English and American markets, and we were assured that nearly all the designs were made in London, where the firm have an atelier at Amberley House, Norfolk Street, Strand, and a staff of artists constantly employed, and that the bulk of the productions of this establishing are sold in London and New York. The firm of Dutton & Co. represent Nister's in New York. In London they have their own branch depôs at 24, St. Bride Street, and 28, Paternoster Row. At Nuremberg they have 140 lithographic artists engaged in drawing on the stone itself, or on prepared transfer-paper to be applied to the stone. Their chief artist, Herr Kuhn, is a most eminent member of the profession and one of the foremost etchers in Germany. We saw a gallery filled with his paintings and etchings at the exhibition, and among them some very clever portraits.

Many of the lithographers are trained on the works, and attend the Kunst-Gewerbe-Schule at night, and M. Loefftz bore willing testimony to the advantages derived from the Art School. In the case of elaborate designs many separate stones have to be used, and each stone has to be worked up and prepared for its particular colour. We saw designs in all stages, mostly for picture-books and cards. The Christmas cards for 1896 are already in the market, they are engaged on the supply for 1897, and even on the almanacks and calendars for 1898.

In the various workshops we were shown all the different processes of embossing and stamping cards; the latter in hand-presses furnished with powerful lever handles. Nearly all this work was being done by women. We also saw the folding and binding, employing many work people, the binding is chiefly done by men. Passing into the printing room, we found numerous large steam-driven presses at which, in most cases, one man and two women were employed. It is usual to put numerous copies of the same design on the stone, so that as many as 20 impressions of the same subject are printed at once. The stone used are about 4 feet square. Some of the presses were rotary, others were of the earlier type. All the machinery was German. We saw women engaged in dusting the back of the sheets with powdered French chalk to prevent the pages from sticking together. In another department we saw the chromo printing, for the pottery transfers. This is quite a similar process to the ordinary chromo printing. We were conducted to the oldest part of the works, where we were shown the photogravure and various photographic reproduction processes, and we saw also the special department devoted to etchings.

The women workers at this establishment earn, we were told, from 8s. to 12s. per week, and there can be no doubt but that the lithographers and artistically trained workers earn wages but little lower than those paid to similar work people in this country. It must be remembered, however, that colour-printing of this kind has long been practised in Nuremberg. Still it is strange to find in this far-off city a hive of busy workers nearly all whose productions are destined for England and America. We watched the work people leaving at the dinner-hour, at which time everyone goes home, and we were very favourably impressed with their general appearance. There are about 750 hands engaged at this period of the year.

The display of Mr. Nister's works at the Exhibition was most artistic. The cases, covered with green plush and decorated with ormolu work in the "Adams" or

"Empire" style, were beautifully designed, and the wonderful variety of choice cards, engravings and illustrated picture-books greatly interested us.

The works of the firm in question are but types of many similar establishments for colour-printing on the Continent, working largely for the English market. At Stuttgart we were shown the works of Mr. M. Seeger, who produced the illustrated advertisement of the Exhibition, the Figure of Electricity, taken from Professor Keller's fresco. The German lithographer has some advantage over his English rival in the relatively much lower cost of the lithographic stones, which come from Solenhofen, in Bavaria, but we were told that the best of the stones is exported to other countries, and only cheaper qualities are used for the home trade. A very considerable capital must be sunk in the supply of stones for a large works. The artist at Herr Seeger's told us that the bulk of the work was not drawn direct on the stone but on prepared transfer paper, which reversed the drawing and enabled the draughtsman to follow the design as it would appear when printed. Herr Seeger does not do any work for England.

Another large establishment visited by us was the works of the Union Company, formerly Cotta & Co., the publishers of the writings of Schiller and Goethe. This fs the largest printing concern in Germany, and probably in the world, as it employs 800 hands. We were shown all the different departments, including the Atelier for the engravers and the colour-printing. This firm produces its own type in a special factory, and publishes several illustrated papers, some of them having coloured illustrations.

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